Vol. VIII, Number 1 Spring 2000

QRPp

NorCal QRP Club EST.1993

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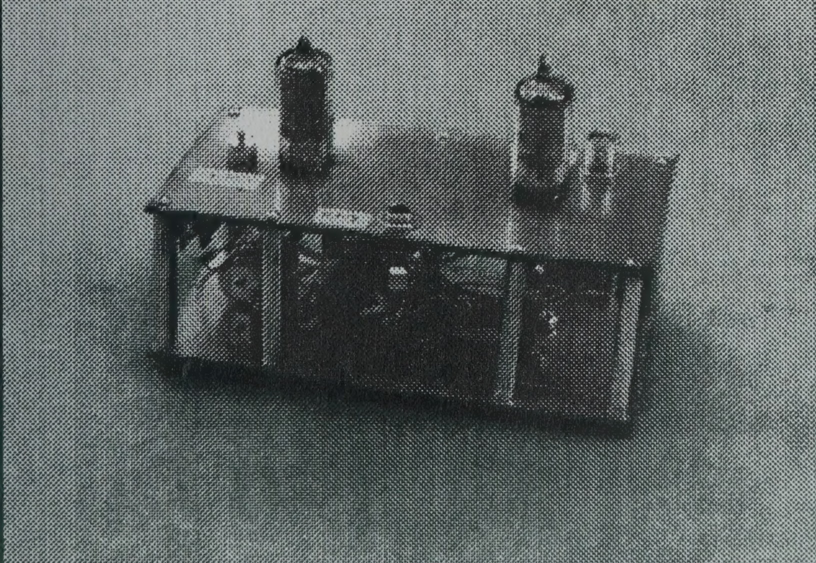
"The Tuber"
K6BSU's QRP Transmitter



Journal of the Northern California QRP Club

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From the Editor
by Doug Hendricks, KI6DS

It is so nice to be back in the groove again. I underwent triple bypass surgery in late November, and have been recovering very well. Paul Harden, NA5N, stepped in and did the entire Winter 99 issue for me, thank you Paul, you are a true friend. Thank you to all who sent cards and messages, you will never know how much it helped. I am doing fine, the prognosis is excellent, and I will be up to full speed very soon, if not by the time you read this. I returned to work on Feb. 1st, and have had no problems.

Because of my health, we have been very late and off schedule with QRPp. You have all been very patient. I thank you for that. We have made some changes. Paul Maciel, AK1P, is now handling the database for the mailing list for QRPp. If you have a question about your subscription, please contact him. His email address is pmaciel@inow.com. His mailing address is: PAUL A. MACIEL, 1749 HUDSON DR. SAN JOSE, CA 95124. Enjoy the issue and it is great to be back. 72, Doug, KI6DS

St. Louis Pocket Vertical & St. Louis Coil

by Dave Gauding, NF0R
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The St. Louis Pocket Vertical (SLPV) features a tapped air-wound St. Louis Coil. It is a high performance self-supporting portable antenna for travelers, bicyclists, backpackers and hikers. This useful 10-40M project can be built with readily available components and hand tools at a reasonable cost.

Components

Loading Coil: The St. Louis Coil design is patterned after B&W Airduxâ. A heavy-duty mailing tube serves as a construction form. Slotted grommet edging supports and spaces the coil wire.

Support: The sixteen foot high break-down antenna support is fabricated from lightweight fiberglass kite tubing. A guying ring positioned at the six foot level also serves as the elevated coil mount.

Mounting Base: Additional fiberglass tubing and internal reinforcements form the mounting base. The base adapts to either hard or soft earth installations.

Feedpoint: This assembly with builder's choice of antenna connector is fabricated from double-sided printed circuit board material.

Radials: St. Louis Radials or an equivalent portable radial system is recommended for the SLPV.

Feedline: Any 50 ohm coax.

Materials, Parts & Tools

4 ea.	54.5 inch x .505 diam eter fiberglass tubing. (Note 1)
1 ea.	54.5 inch x .414 diam eter fiberglass tubing (Note 1
4 ea.	3-1/2 inch x .411 diam eter internal fiberglass coupler (Note 1)
1 ea.	rubber end cap, 1/2 inch diameter (Note 1)
1 ea.	slotted-wall grommet edging, nylon, 12-3/4 inches (Note 2)
1 ea.	hard plastic stock, 1/8 inch thickness, 1-1/2 inch square
1 ea.	doubled-sided printed circuit board, 2-3/4 inch square
1 ea.	antenna jack, bulkhead (see construc tion notes)

22 ft braided black nylon guy

line, 1/8 inch diameter

2 ea.	brass fishing swivel, size #05
6 ea.	brass fishing swivel, size #01
16 ft.	solid copper wire, #14
4 in.	#18 insulated wire, stranded
20 ft.	ribbon cable (flat com puter cable), stranded, two conductors
3 ea.	medium alligator clips, serrated jaw (Note 3)
1 ea.	micro alligator clips, smooth jaw (Note 3)
4 ea.	heatshrink tubing, 1/8 inch diameter, 1 inch length
4 ea.	heatshrink tubing, 3/16 inch diameter, 1 inch length
3 in.	brass tubing, 3/32 inch diameter (Note 4)
4 in.	heavy-duty cardboard mailing tube, 3-1/4 inch diameter, 1/8 inch wall minimum
4 ea.	barn nail, 6 inch length or 3/16 inch diameter equivalent
8 ea.	2-56 x 3/8 inch machine screw
8 ea.	2-56 nut
24 ea.	2-56 washer (#2 flat washer)
1 ea.	Goop® sealant/adhesive, 3.7 ounce tube (Note 5)
1 ea.	two-part epoxy cement kit, 30 minute work-time
1 ea.	high-speed drill bit, 5/64 inch diameter
1 ea	high-speed drill bit, 1/8 inch diameter
1 ea.	high-speed drill bit, 1/4 inch diameter
1 ea.	tapered reamer, 1/2 inch/13mm diameter
1 ea.	aluminum miter box (Note 4)
1 ea.	mini-hacksaw, 32-TPI blade (Note 6)

Other Hand Tools & Supplies

Standard hacksaw, files(s), fine emery paper, steel wool, combination square, wire cutters, needle-nose pliers, small screwdriver(s), ruler, tape measure, masking tape, soldering iron, solder, extra medium alligator clips, cellophane tape, isopropyl alcohol and a lubricant. Optional items include a hobby saw, nibbler, cartridge de-burring tool, clamps and a 1/16 inch drill bit.

Support Construction

1. Using the fine pitch mini-hacksaw trim the .505 fiberglass tubing into ten 18 inch sections, one 12 inch section and one 6 inch section. Use the miter box to produce a square cut. Rotate the tubing while cutting to control splintering. Finish the trimmed edges inside and out with a tapered reamer and emery paper.

2. Trim ten 2-1/2 inch ferrules

from .414 tubing and finish as above. Mark a reference line 3/4 inch from the end of a ferrule. Apply epoxy cement. Insert this end into an 18 inch section allowing 1-3/4 inches of the ferrule to project from the assembly. Repeat for the ten 18 inch sections. Cure overnight. Note this is the recommended time allowance for each cemented part.

3. Trim a 1/2 inch ferrule from remaining stock. Square the end and epoxy flush into the top of the 12 inch tube. This is now the tip section and holds the cotter pin eye for the upper radiator wire.

4. Drill a hole 3/8 inch from the top edge to match the diameter of the cotter pin. The hole can pass through both sides of the tubing. Trim so the eye projects just far enough from the tubing to accept the #05 fishing swivel holding the upper radiator. Install with epoxy cement.

5. Trim a 1-3/4 inch diameter disk from 1/8 inch plastic stock. Drill a hole in the center. Finish with a tapered reamer for a snug slip fit over a ferrule. Drill three equidistant 1/8 inch holes with centers 1/4 inch from the sides of the disk. This disk supports the upper end of the guy lines and serves as an insulated base for the air-wound coil.

6. Cut three 7 foot sections of nylon guy line. Terminate each end in a #01 fishing swivel and a locked knot. Melt the ends to prevent unraveling. The guy line assemblies install in a compact 5 foot diameter footprint.

7. For the guying stakes begin by cutting the barn nails to a length of 4-3/4 inches. Cement into each of three .411 fiberglass internal couplers leaving 3-1/2 inches exposed. Allow these assemblies to cure overnight.

8. The guying stakes socket into each other and then store conveniently inside an 18 inch tubing section. Add the rubber end cap to complete the packaging. Small screwdrivers stored separately can substitute for the custom guying stakes. Philips-type heads aid insertion into hard earth.

Base Mount Construction

1. Trim a 2-1/2 inch ferrule and apply epoxy cement. Insert into the 6 inch section of .505 tubing leaving 1-3/4 inches projecting from the end. The lower end of the support tubing will be socketed on this ferrule.

2. Using a file bevel one end of the last .411 fiberglass internal ferrule to a 35-45 degree angle. This alteration will aid installation in soft-ground locations.

Now apply epoxy cement to the squared end of the coupler and insert in the bottom end of the tubing leaving 1 inch exposed.

3. Cut the head off the last barn nail. Sharpen the end by filing down each of the facets. Apply epoxy cement to the shank. Insert in the .411 coupler leaving 4-1/2 inches exposed to serve as a base pin. Set the completed assembly aside to cure overnight.

4. The base pin followed by graduated steps helps the mount adapt to a variety of soil conditions. The sharpened point stores safely inside the support's tip section. Add a cellophane tape collar to the .411 coupler body for a snug fit.

Feedpoint Construction

1. Trim a 2-3/4 inch diameter disk from the double-sided printed circuit board material. Drill a 1/4 inch hole in the center. Use a tapered reamer for enlarging and finishing. The feedpoint disk should have a friction fit along the base mount ferrule. Then drill another hole in the disk sized for the bulkhead antenna jack.

2. Form a 1/4 inch diameter loop from solid wire along with an 1/8 inch lead. Solder into the solder cup of the jack. This serves as a solid attachment point for the alligator clip terminating the lower radiator.

3. Polish both sides of the pcb material with steel wool. Install the antenna jack firmly with a toothed or split-ring washer to ground both sides of the disk. Portable radials attach quickly to this assembly using alligator clips. The feedpoint offers some wet weather protection for the coaxial connection.

Coil Construction

1. The SLPV features a St. Louis Coil for 10-40M built on a 3-1/4 inch diameter cardboard mailing tube form. The frequency coverage as well as the diameter and length of the coil can be changed to meet builder requirements. No alternate coil winding data is available.

2. With a hacksaw or diagonal cutters trim four grommets containing nineteen complete notches. Using the 5/64 inch drill bit place holes for the 2-56 attachment hardware in the outboard notches in the top and bottom of each grommet. Now drill additional holes in the second bays of grommets number 1 and number 3. These holes are identified as points A & B and points C & D in the diagram. The letters mark the locations of the horizontal coil supports.

3. Locate equidistant positions around the mailing tube for the four grommets. Layout vertical guidelines using a combination square. Then drill twelve matching holes in the tube with the 5/64 inch drill using each grommet as a separate template. Now install the grommets with the 2-56 hardware using the outside holes at the top and bottom of each grommet.

4. Place two washers between the grommet and the coil form. Place one washer between the nut and the coil form. Removing the stacked washers later helps to ease the completed coil off the cardboard without damage. The coil form is re-usable.

5. Attach the far end of the #14 wire to a solid object. This provides constant tension on the wire
while turns are placed on the coil. The wire should be taut but not so tight as to distort the grommets.

6. These instructions are for a right hand coil. The starting point is on the left side of the form. Push the wire through the locating hole at point A. Allow the wire to project 1/2 inch inside the cardboard. Begin winding the coil clockwise after making a tight 90 degree turn to lock the wire in place. The stub will serve as the attachment point for the upper horizontal coil support.

7. Continue winding the coil towards the right side of the form placing uniform pressure on the wire. Drop down one notch each time the wire meets itself. Inspect to insure the wire is positioned firmly in the bottom of each notch.

8. Finish the winding by trimming the wire 1 inch past grommet 3. Then bend the wire into a 90 degree angle at point C and push the wire through the opening. Pull the wire taut using a pliers. Trim the wire so it projects 1/2 inch inside the coil form. This stub will serve as an attachment point for the horizontal support at the bottom of the coil and the tap wire assembly.

9. Install the applicator tip on the Goop tube. Cut off the end of the tip at the first step. Apply a bead of the adhesive along the top of the turns inside grommet 1. The rule-of-thumb for bead size is three-quarters of the width of the grommet before the adhesive starts to settle. Avoid putting adhesive over the holes at points A & B and C & D and beyond at this time.

10. Now rest the upper edges of the nylon grommet under a 100W light bulb positioned horizontally. Slide the grommet

back and forth so the Goop is exposed to heat. Several slow full-length passes over a sixty-second period are sufficient. The warmed adhesive will pass through the coil wire and onto the body of the grommet to create the bond. Repeat the process for each grommet. Cure for a minimum of twenty-four hours before handling.

11. Remove the coil attachment hardware. Lift the ends of the grommets and slide the stacked washers free with a small screwdriver blade. Push the wire stub at point A and point C outwards until they are just clear of the coil form. The fit between the coil and the form will be tight. Use finger pressure on the ends of the grommets and gently ease the coil off the form in small increments. Then bend both wire stubs back into position.

12. If it is difficult to separate the coil from the form score the mailing tube internally with a fine hobby saw. It is not necessary to cut completely through the cardboard. Using a screwdriver passed between turns gently bend one edge of the cut inwards to reduce friction. Then remove the coil.

13. The coil supports are fabricated from a single piece of #14 wire. For the lower support start with 8 inches of wire. Bend around a .505 tube section to create a coil-centering ring. Continue looping the wire until it forms an angle of 300 degrees. This occurs at approximately 1-3/4 turns. Using a pliers bend the wire ends backwards until both extensions are centered on the loop and perfectly straight. Confirm the fit along the fiberglass tube. Squeeze the turns together with an alligator clip and solder closed. Pre-trim each wire extension to 2 inches.

14. The tap assembly is installed on the lower coil support. Begin with 3-1/2 inches of #18 insulated stranded wire. Strip 1/4 inch and solder the wire into the body of the micro-alligator clip. Fold the crimp tabs over the insulation and finish the connection with 1/8 inch heatshrink tubing.

15. Using the mini-hack saw trim a 3/4 inch length of 3/32 inch brass tubing. Then cut this tube almost through in the middle to form a socket. Bend open to an angle of 300 degrees. Slide on to the lower or outboard arm of the horizontal support wire with the cut opening facing inside. Do not solder the socket or tap wire in place at this time.

16. Trim a 1/2 inch length of 3/32 inch brass tubing to serve as a coupler between the coil stub at point C and the inboard end

of the horizontal support wire. Slide the coupler on the stub. Now slide the end of horizontal support with its previously prepared tap socket through the bottom hole of grommet 1.

17. Trim the horizontal support until the wire ends at point C are socketed in both sides of the coupler and the coil ring is centered. The stepped configuration of the outboard wire extension allows the tap socket to mate with the pre-drilled hole at the bottom of grommet 1.

18. During fitting several medium alligator clips are useful for holding the horizontal supports in their final positions and for heatsinking. Now heatsink the coil centering ring. Heatsink the wire stub at grommet 3. Then solder both sides of the coupler to the wires. Trim the excess wire flush where it projects past the edge of grommet 1.

19. Slide the tap socket along the horizontal support and position 3/8 inch from grommet 1. Confirm that the socket will not interfere with the guying ring when the coil is installed on the tubing. Tack-solder the socket to the horizontal support with the tap wire opening pointing down.

20. Heatsink the support at grommets 1 and 3. Heatsink the soldered joints on both sides of the support coupler. Heatsink the soldered joint on the coil-centering ring.

21. Now strip 1/2 inch of insulation from the tap wire and add the last 1/8 inch heatshrink tubing. Put the tap wire in position and heatsink the tap wire insulation where it touches the socket.

22. Elevate the coil and work from below. Solder the tap socket and the tap wire at the same time. To insure a strong joint the tap wire itself should pass through the socket and meet the horizontal support. Heatshrink the tap wire connection in the socket to finish the assembly.

23. Refer to paragraphs 13 through 18 for completing the upper horizontal support after omitting the tap feature.

24. Confirm the fit of the coil on the guying ring and along the fiberglass upright. File all soldered joints smooth. Fill the grommets at points A and C with additional Goop after clamping or taping the horizontal supports in their final locations. After curing trim off the unneeded grommet material

25. The standard SLPV coil has a measured inductance of 18 microhenries and a "Q" of 350.

There are sixteen full-turns and two half-turns. The coil contains 14-3/4 feet of wire including the horizontal supports and tap assembly.

Radiator Construction

1. Two shorted parallel conductors of ribbon cable are used for the upper and lower radiators. This wire configuration is lightweight, strong and most importantly resists tangling during handling. Measure for the radiators after the fiberglass support and coil are in position overhead.

2. For 40-30-20M install six 18 inch tube sections and the 12 inch tip section. For 17-15M use one 18 inch section and the tip section. For 12-10M no upper radiator is required. Use the tip section for positioning the coil or trim a piece of leftover .505 tubing to length.

3. The upper radiator length varies according to the band. The table (Note 7) provides approximate tip-to-tip dimensions. Start with the #05 fishing swivel soldered in place. Allow for two shallow turns between the cotter pin and the horizontal support at the top of the coil. Now add the 1/8 inch and 3/16 inch heatshrink tubes. Finish the ribbon with a crimped and soldered medium alligator clip. Heatshrink the connections.

4. The lower radiator is a constant at approximately 6 feet. Allow for two shallow turns along the lower support when measuring. Add two lengths of 3/16 inch heatshrink tubing to the wire. Terminate each end in a medium alligator clip as above. Heatshrink the connections.

Radial System

St. Louis Radials (QRPp, Fall 1997) fabricated from ribbon cable are recommended accessories for the SLPV. This is an easily managed and truly portable radial system. Each multiconductor radial attaches to the feedpoint disk with an alligator clip. The ribbons rest on the ground and install or retrieve in minutes.

All construction information is contained in the referenced article. SLR ribbons are also accessories for the St. Louis Express vertical (QRPp, Summer 1998). Additional building and operating notes are contained in that article. Single-length ribbons or the resonant ribbons can be used with the SLPV. Either radial configuration may be optimized for specific bands. The ribbons can be bent near their mid-point to fit available space.

A traditional ground radial system composed of single wires is usable with this antenna in either portable or permanent

locations. The length and number of wires and should be appropriate for a ground-mounted quarter-wave vertical antenna.

On-air testing of the SLPV was carried out with six St. Louis Radials extended full-length from the feedpoint and spaced proportionally. Each ribbon contains 7 parallel 16-1/2 foot conductors. This arrangement places 700 feet of wire under the antenna in a 33 foot diameter footprint.

Installation - Lower Support

1. When the SLPV mounting pin is inserted in firm earth the lower support assembly will free-stand thus expediting the installation process. The following procedures are appropriate for soft ground or sand.

2. Attach the guys to the guying ring. Attach the feedline to the antenna jack and slip the feedpoint disk over the base mount. Position these sub-assemblies where the antenna is to be installed.

3. Insert two guying stakes including guys into the earth at a 45 degree angle about 120 degrees apart. Assemble four 18 inch tubing sections for the lower part of the support. Place the guying ring assembly on the top ferrule.

4. Now bring the lower support to an upright position. Slip it onto the base mount with the previously installed feedpoint disk. Then insert the complete lower support assembly into the earth. Finally, extend and install the third guy.

5. Adjust the guys until the support is vertical. The guys should be firm to the touch but not tight enough to bend the lower support tubing.

Installation - Upper Support, Loading Coil and Radiators

1. Buff the surfaces of the horizontal coil supports with steel wool where the upper and lower radiators will be attached. Buff the coil itself along the tapping bays.

2. Assemble the remaining tubing sections finishing with the tip section. Attach the upper radiator to the cotter pin eye.

3. Hold the coil so the tap assembly is facing down. Slip the base of upper fiberglass support into the coil. Then elevate both sub-assemblies together and place on the ferrule above the guying ring. A smooth vertical rise followed by a prompt drop into position works best.

4. Now attach the upper radiator to the horizontal support wire at

the top of the coil. Attach the lower radiator to the soldered loop on the feedpoint jack and then to its horizontal coil support. Place the shallow turns along the upright to keep each radiator secure.

5. Attach the radial system to the feedpoint disk. This completes the installation and the antenna is ready to be tuned.

Coil Tuning

1. The St. Louis Coil can be matched for each band by trial-and-error using a sensitive low-power SWR bridge. A noise bridge or a direct frequency read-out device may also be used to resonate the antenna.

2. The table (Note 7) provides coarse tap locations for the standard coil and radiator assemblies operating over a St. Louis Radial set. Start with the lowest design frequency and move to the highest.

3. Using 40M as an example begin tuning by attaching the tap to the second turn from the bottom of the grommet supporting the tap wire assembly. When using an SWR bridge apply low power (1-2 watts) and compare the forward and reflected readings.

4. Fine tune by repositioning the tap along that turn on either side of the grommet. During testing the tap wire may be extended temporarily with a jumper. Additional tap options will be discussed in the construction notes section.

5. Expect a 3:1 to 1 SWR reading or higher at non-resonant points. Reaching a 2:1 to 1 SWR suggests the resonant point is on an adjacent turn. Typical SWR at resonance is between 1:2 and 1:5 to 1.

6. Users faced with a difficult match should first try adjusting the upper radiator length. Changing the feedline length is an option. Adding several resonant wire radials specifically for a problem band may be helpful. Finally, a small matching coil could be fitted at the base of the antenna.

7. Apply 5 watts to confirm the accuracy of resonant points determined at low power. Then increase to 50 watts if available. If the SWR increases significantly repeat the tuning process until a reliable match is achieved.

8. Using the SLPV at multiple operating sites means changing RF environments. Besides external influences the proximity of the feedpoint to the earth and even radial positioning become contributing factors. Those and

other complex interactions may call for different tap settings.

9. Once a coarse tap location is established for a band the final match is generally easy to restore. On rare occasions when a tapped coil cannot produce an acceptable SWR the antenna can be fine-tuned with a transmatch after coarse tuning with the tap.

Construction Notes

The standard SLPV tap assembly serves 2 bays and 33 tapping points. The tap wire may be built longer to reach the all bays in the coil though this is not normally necessary to achieve a usable match.

The tap design can be simplified by converting to a separate jumper wire with dual-alligator clip terminations. The jumper attaches anywhere on the lower horizontal support or to the end of the coil assembly at point C. This tap option is useful for emergency repairs and is a recommended accessory for an SLPV routinely exposed to rough handling in the field.

The coil may be built with detents in the bays. The tapping points decrease by one-half. However, the option may be appealing to some users as the possibility of shorting-out adjacent turns is reduced. Upper and lower radiator lengths remain the same. An updated coil-tuning table is required.

To make the detents support the coil firmly in one hand. Starting with the second turn from the bottom in each bay push the center of every other turn inwards with a small flat-blade screwdriver. Apply pressure gently but firmly until the wire stops bending. The detents deflect about 1/2 inch. There is sufficient working space to replace the micro-alligator clip with a small serrated-jaw alligator clip.

The standard coil is adaptable to single-band use in a permanent location. Once an acceptable match is found replace the tap wire assembly with solid copper wire and solder in place. Route the wire inside the coil.

Choosing #14 copper wire for the coil was a compromise decision. #12 wire would provide better structural rigidity but it is heavier and slightly oversized for the .067 inch notches molded into the grommets.

Straightening out bumps in the copper wire by hand before winding the coil produces a more attractive sub-assembly and ultimately saves hand labor. Burnishing the fully extended wire with a fine steel-wool pad before winding is helpful as well. Use a needle-nose pliers for the final alignment of turns in a completed coil. Work from the edge of a grommet towards the center.

A compact mini hack-saw

(Note 6) with a very thin low-profile 32-TPI blade is recommended for trimming fiberglass stock manually. Thicker and deeper blades such as common 32-TPI hacksaw blades tend to splinter the brittle fibers. The rough edges require additional hand-work for a proper finish.

Alternative cutting methods include a hi-speed cutting disk or a lathe running at slow speed with a well-sharpened cutting tool. The performance of a fine-pitch razor saw varies in this application.

A handloader's cartridge case de-burring tool is handy for cleaning-up the cut edges of fiberglass tubing in place of a tapered reamer and emery paper.

The 3/32 inch diameter brass tubing tends to burr even when trimmed with the mini-hacksaw. A 1/16 inch drill bit is useful for restoring the fit of the tubing to #14 copper wire.

The heavy-duty 1/8 inch (minimum) wall mailing-tube is mandatory. It insures the form does not collapse under pressure from the coil during winding and subsequently aids with removal. Cut at least one end of the tube square with a hacksaw to insure the grommet reference lines are located properly.

Apply a coating of WD-40 or a silicone lubricant to the bottom of the grommets before installing them on the form. This provision is helpful when it is time to remove the wound coil. Do not spray the cardboard directly.

There is room for at least three types of bulkhead antenna jacks on the standard feedpoint assembly. A full array includes a BNC, SO-239 and a double-binding post. The latter is suitable for a coaxial feedline without a mating connector.

The guying ring and feedpoint disk can be constructed as a square, triangle, hexagon as well as a circle. Cutting pcb material or plastic stock with a hacksaw instead of a nibbler may be more convenient for some builders.

The mating surfaces of the fiberglass tube sections and ferrules must be thoroughly degreased before epoxy cement is applied. Isopropyl alcohol on a Q-tip works well.

After construction the inside of each tube section and ferrule must be cleaned. This procedure removes fiberglass shavings and manufacturing residues that might otherwise foul the close fit between tubing and ferrule. Use a simple tissue plug sprayed with WD-40 or an equivalent product. Push the plug from end-to-end with a rod before the support is assembled. Finish with an isopropyl alcohol swab.

Depending on manufacturer or production lot the fit of fiberglass tube to internal ferrule may not be perfect. Minimum clear-

ance can be improved by using fine emery paper to reduce the diameter of the ferrule slightly. Proceed very slowly and test periodically for best results. A snug fit is desirable to insure the rigidity of the assembled support.

The standard SLPV is best suited to users not less than 5' 8" tall. This assumes installation of the upper fiberglass support at arms length while standing at ground level. The configuration of the support assembly is not critical. The positioning of the coil and radiators may be scaled up or down to meet builder nèeds.

Portability Features

The final prototype SLPV with accessories and a standard St. Louis Radial set weighs 40 ounces without feedline. The fiberglass support with guying stakes stored internally and its companion mounting base bundle into a compact 2 inch diameter roll. Several 5/8 inch width small-diameter rubber bands used by food stores for fresh produce packaging are perfect for holding the tubes in place.

The disassembled support is less than 20 inches long. This feature allows the tubes to pack vertically inside a typical F.A.A. approved 21 inch rolling carry-on bag favored by air travelers.

The SLPV support also fits conveniently inside a mailing tube. Add foam plugs inside the end caps to keep the fiberglass sections in place and trim the cardboard to length. The sections can be shortened to 16 inches (or less) overall to fit in a standard business briefcase or backpack.

While the homebrew antenna coil and companion radiators are quite durable the soft copper wire should be protected when not in use. Another cardboard mailing tube with foam endplugs attached is a good choice. The feedpoint, guying assembly plus doubled and rolled St. Louis Radials will pack easily into a round rubber kitchen container.

Performance Issues

The SLPV was designed with the low-power portable operator in mind. Nevetheless, the antenna has handled 50W continuously and 100W intermittently during testing. The upper power limit for each band has not been determined. The coil will de-tune when the closely spaced turns are wet with heavy-dew or rain. Options include operating temporarily with a higher SWR or removing the coil and drying it. A can of compressed air is a convenient alternative. Users should also anticipate changes in SWR readings between dry ground and wet ground locations. For short-term operating (on 20M only) jumper the full-length upper and lower

ribbon cable radiators with 3 inches of solid copper wire. The connected elements are resonant on the low end of the band.

Choose any 50 ohm coax feedline including a short length of RG-174 should carried weight and volume take precedence. The final SLPV prototype continues with field-testing using 75 feet of RG-58 coax. The feedline has a coiled choke at the feedpoint and BNC connectors at both ends.

The standard 16 foot SLPV support will suspend a lightweight dipole, inverted-vee or random wire. The specialized St. Louis Doublet (QRPp, Spring 1999) and the NorCal Doublet (QRPp, Winter 2000) are appropriate for this application. With the addition of a second guying assembly and modified installation techniques the .505 fiberglass tubing can be extended to 20-22 feet.

Excess .505 and .414 tubing can be converted into extenders to restore feedpoint height when the base mount is inserted deeply into soft ground or sand. Grind down the anti-withdrawal rings on barn spikes used in the mounting base and guying stakes. Then coat with epoxy glue. This controls rusting and makes it easier to remove dirt and debris.

The close part tolerances that insure rigidity in the fiberglass support system are a potential drawback for the portable operator. Temperature extremes may tighten clearances to a point where assembly and disassembly are difficult. Several flexible rubber pads designed for gripping bottle lids are a useful addition to the field kit.

Finally, a very specific reminder that nearby foliage, structures, automobiles and antennas tend to absorb vertically polarized RF. With this in mind users should make every effort to position the SLPV in the clear for best results on the air.

Other Coil Applications

A St. Louis Coil can replace the base-mounted twinlead coil of the original St. Louis Vertical. Size the coil-centering rings for a slip-fit on the tapered body of the 20 foot South Bend collapsible fiberglass fishing pole or similar products. The coil can rest on an edge where sections telescope or on a tie-wrap stop.

The modified coil is placed on the pole before it is installed. Therefore it is possible to locate the coil higher on the support than the 6 foot level used for the SLPV. The base of the pole and feedpoint may also be raised further. Changing taps on an elevated coil requires more time but the potential for reduced ground losses and a lower angle of radiation makes it an attractive option.

Customized St. Louis Coils

can be used for shortened wire dipoles. Lighter coil wire and lower profile grommet edging are suggested for this application.

A St. Louis Coil has been tested in place of the toroid inductor in an original St. Louis Tuner kit (QRPp, March 1996). Due to its larger cabinet the NorCal version is better suited to this modification.

Antecedents & Variations

W6MMA's commercial coil modification for the St. Louis Vertical readily adapts to the SLPV support system. Place the SLV/W6MMA coil for 10-40M on top of the guying ring. Tune normally after trial fitting new upper radiators. The foam bushings may have to be replaced to center the pvc form on the fiberglass tubing. See

http://www.fix.net/~jparker/w6mma.htm

AE0CW's (ex-N0TFI) homebrew tapped coil modification for the St. Louis Vertical uses foam pipe insulation for a coil form. In addition to being ultra-lightweight this inexpensive design builds quickly and is easily fitted to the SLPV support. See

http://www.rmham.org/ae0cw

The three-point St. Louis Pocket Vertical guying system is based on the Random Wire Vertical antenna (QRP Quarterly, January 1995) or see

http://www.g3ycc.karoo.net

Extending the guy lines to 8-1/2 feet provides a convenient tent (or lean-to) foundation for camping. Each side of the tent is 9 feet long at the base. A fully enclosed space sleeps three persons plus some gear. The height of the guying ring allows an adult to stand upright. No tent plans are available.

Conclusion

The St. Louis Pocket Vertical with a St. Louis Coil is a specialized portable antenna for the outdoor enthusiast, vacationer or business traveler. It is compact, self-supporting, lightweight and provides 10-40M capability practically anywhere in just a few minutes.

The SLPV project was under development for over one year. Four prototypes were constructed to verify electrical and mechanical function. Informal on-air testing conducted over several months included two hundred CW contacts at one-watt output across seven bands. That log is available to prospective builders. E-mail requests to nf0r@slacc.com with "SLPV

Test Log" on the subject line.

The radiator uses a proven vertical antenna concept that is well-documented in amateur radio antenna manuals. Users will not be disappointed with performance either in the field or at home. As always, modifications and improvements are officially encouraged.

The text fully upholds homebrewers wishing to construct the complete antenna or only the coil. The SLPV project is labor intense though not without appropriate rewards. Having said this both authors concur that it has taken longer to write this article than to build and field test any of the prototypes.

Text Notes and Tuning Table

1. Fiberglass kite tubing is available from Hang-em-High at

http://www.citystar.com/hang-em-high/cat-2.html

or (804)233-6155. Reference p/n FGT505 and p/n FGT414. Note that the .414 tubing used for internal ferrules is not carried by all retailers of kite building materials. The drilled solid fiberglass rod used for internal couplers in .505 tubing is p/n IF411. The rubber end cap for .505 tubing is p/n VEC12.

2. Slotted-wall nylon grommet edging is typically an OEM product but available by the piece from some electronics parts distributors and surplus outlets. The SLPV prototypes use Panduit p/n GE-192. An example is pictured on page 136 of an on-line catalog at

http://www.panduit.com

The manufacturer of this semi-rigid material is not critical. However, the slot width should be .067 to match the diameter of #14 copper wire. Note that grommet edging is not the same product as caterpillar grommet which is flexible and sold on spools.

3. The medium alligator clip (RS 270-346B) and small smooth-jaw micro alligator clip (RS 270-373B) are stock items at most Radio Shack® stores.

4. 3/32 inch diameter brass tubing and a small ExcelÔ Hobby Tools #55665 aluminum miter box are available at many full-line hobby shops. See

http://www.phoenix-model.com

for a picture.

5. Goop®, a clear non-silicone sealant/adhesive, is available at most major hardware and automotive supply stores. Any variation within the product family is usable. The marine, outdoor and

sportsman types are UV resistant to limit discoloration. Call (800)349-4667 for local retail sources other than Home Depot, Lowes, Wal-Mart, Tru-Value, etc. There is no active website for this product.

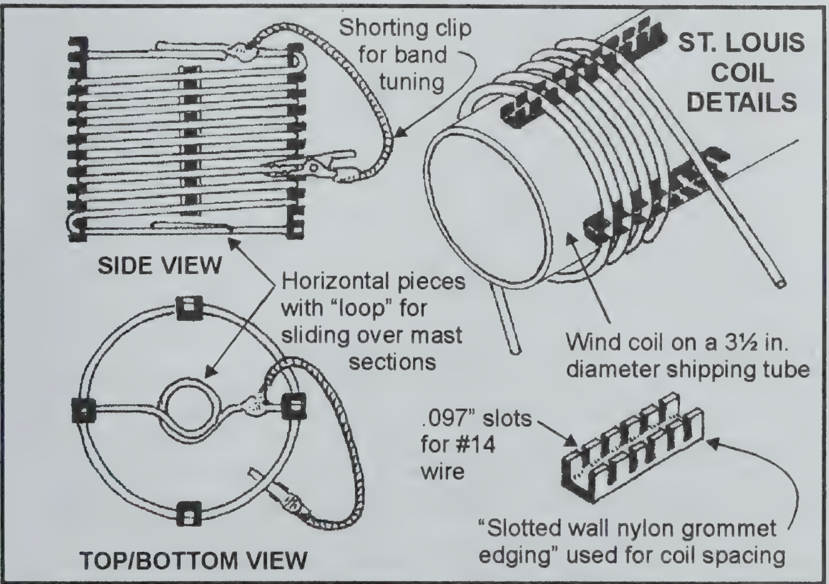
6. A Zona #680 Junior Hack-Saw is carried by "Into The Wind" at

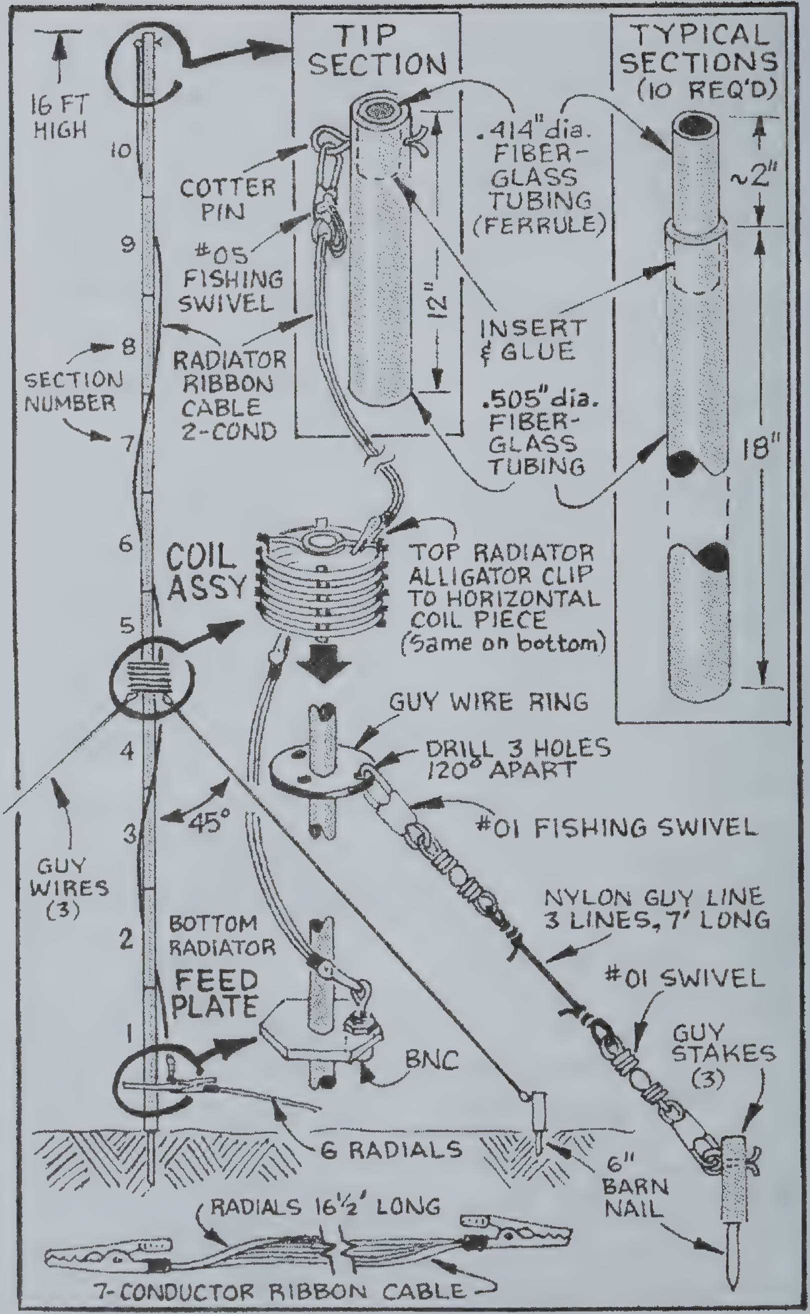
http://www.intothewind.com

or (800)541-0314. Reference the nine-inch #4920 saw and #4921 32-TPI saw blades for cutting fiberglass. An imported mini-hacksaw with 32-TPI blade recommended for cutting fiberglass tubing is available from Hang-em-High (Note 1) but has not been tested. Reference p/n SAW and p/n SAWB. These specialized saws can be found in some local hobby, woodworking and craft stores.

7. Coarse Tap Points for the Standard SLPV Coil (measured from bottom of coil at grommet 1) and Upper Radiator Lengths (approximate):

Band	Turn #	Upper Radiator
40M	02	118"
30M	10	118"
20M	16	118"
17M	09	28"
15M	12	28"
12M	06	Not Used
10M	09	Not Used





St. Louis Pocket Vertical Antenna

Tuber: Vacuum State Transmitter

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It doesn't seem very long ago that we designed and built our equipment using tubes. Here's a chance to take a trip into nostalgia-land and re-discover the fun of operating at night by the soft orange glow of the filaments.

The "Two-ber" is a 40 Meter crystal-controlled transmitter that delivers 300 mW into a 50 ohm load, thus putting it into the QRPp category. It uses two 6AU6 pentode tubes in a MOPA (Master Oscillator Power Amplifier) circuit. Why two tubes? Because "One-Ber" or "Three-Ber" would sound dumb. As a bonus, there is one tube to warm each hand on a cold evening.

I have long since scrapped my high voltage power supplies, and I imagine most other hams have also. Therefore, I designed the Two-ber to operate from 12 volts dc. This can be any convenient supply, but I was thinking of a 12 volt car battery for Field Day or QRP-to-the-field operation. The high voltage (remember that stuff?) is generated by a dc-dc converter, also running from 12 volts. Key-down current from 12 volts is 500 mA, with 300 mA of that total going to light up the series-connected filaments.

The 6AU6 is a high gain pentode receiving tube. Perhaps other types would operate as well. However, there are still a few million 6AU6 tubes out there, whereas some of the more exotic bottles are hard to find. Many small tubes are still available at ham swap-meets for about $1 each. In a pinch, you can actually order tubes from Radio Shack! (but be prepared to write a big check).

V1 is a TGTP (Tuned grid, tuned plate) oscillator. The crystal frequency at 40 Meters can be moved 6 Khz total by C1 acting with RFC1. My crystal, purchased from Doug Hendricks, is marked "7040 KHz" and it tunes from 7037 KHz to 7043 KHz.

The oscillator tube runs continually during transmit, and keying is done at the amplifier cathode. Z1 provides cutoff bias for the amplifier tube, boosting its efficiency and power output. A double pi network transforms the amplifier tube impedance down to 50 ohms. The large impedance transfer ratio requires a double-pi network, which also helps with cleaning up the har-

monics. I no longer have access to my beloved spectrum analyzer at Lockheed, (I am now retired) but the output looks good on a 'scope and its harmonics as found on a general coverage receiver up to 30 MHz are really weak. I can't verify if this rig meets the usual harmonic suppression goals, but it appears to.

200 Volt Supply

The 200 volt high voltage dc source is generated by a dc-dc converter running from the 12 volt battery. The converter design uses a conventional two transistor multivibrator circuit. The "E-core" transformer is from Amidon, and is quite easy to wind. A Nylon bobbin is supplied with the two transformer cores. Place a 1/4" X 1/4" stick of wood through the bobbin for ease of winding. The 300 turn secondary is wound first. Reel off about 4 feet of wire from your wire spool and clamp the spool in a vise. Pull the wire just slightly taught and wind it onto the bobbin by rotating the bobbin. This prevents kinks in the wire. Repeat the procedure with another 4 feet of wire. You will get about 30 turns per layer. So 10 layers should complete it. Wind the layers as evenly as possible to conserve space on the bobbin. A layer of insulating tape is applied before doing the primary and feedback windings. After completing the windings, slip the two E-cores in place and epoxy them together. If the converter doesn't start up, reverse the feedback wires to the two transistor bases. The converter runs at 12 KHz and is quite vigorous. It will run down to 3 volts input. Don't omit the 100K bleeder resistor. It discharges the HV when you turn the dc-dc converter off during receive. Otherwise, the Xtal oscillator will continue to run too long.

Construction

I built the Two-ber in "the open", so that I could do the show-and-tell thing at our club meeting. The RF deck is made on a piece of two sided copperclad PC board, and the power supply on another piece of PC board. Wiring is point-to-point using the tube sockets and solder terminal strips from Radio Shack. The power supply transistors use the copper PC board material as a heat sink. Cut grooves in the copper board material to isolate the collectors of the power transistors. Many of the parts come from Radio Shack, and these are identified in the parts list.

Operation

Tune-up consists of peaking up C4 and C11 for maximum output into a dummy load, then into an antenna. You need an

insulated tool for this. Remember, you are no longer working with a 9 volt transistor radio battery here! (keep one hand in your pocket when working with high voltage, as I was told in the army).

Not shown on the diagram is a DPDT switch which was later added to switch the antenna to a receiver, and to cut off the 12 volts to the dc-dc converter during receive periods. Of course, the 12V to the tube heaters must stay on all the time. It is a good idea to install a 1 Amp in-line fuse in the +12 volt battery circuit for safety reasons.

PARTS LIST: TWO-BER

V1, V2	6AU6 or 6AU6A
RFC1	47 uHy RF choke
RFC2	1 mHy RF choke
C1, C4	9-100 pFd trimmer capacitor R.S. #RSU-11880051
C3	470 pFd silver mica
C5	150 pFd silver mica
C2, C6, C10	0.01 uFd disc ceramic, 500 V R.S. # 272-131
C7, C9	0.001 uFd disc ceramic, 500 V R.S. #272-126
C8	0.1 uFd mylar, 500V R.S. #272-1053
C11	10-180 pFd trimmer capacitor R.S. #RSU-11919099
C12	300 pFd silver mica
C13	750 pFd silver mica
C14, C15	0.1 uFd ceramic, 50V R.S. #272-1069
Z1	1N4735. 6.2 volt Zener diode R.S. #276-561
L1	12.9 uHy 51 T. #30. Amidon T50-2 core
L2	6 uHy 35 T. #30. Amidon T50-2 core
L3	3.57 uHy 27 T. #30. Amidon T50-2 core
All resistors	1/4 or 1/2 Watt 5%
POWER SUPPLY	
Q1, Q2	TIP42 PNP power transistor R.S. #RSU-11371259
C1,C3	1 uFd elect. 35V R.S. #272-1013
C2	10 uFd elect. 350 V
R1	220 ohm 1/2 Watt
R2	100K ohm 1/2 Watt
D1-D4	1N4004 diode R.S. #276-1103

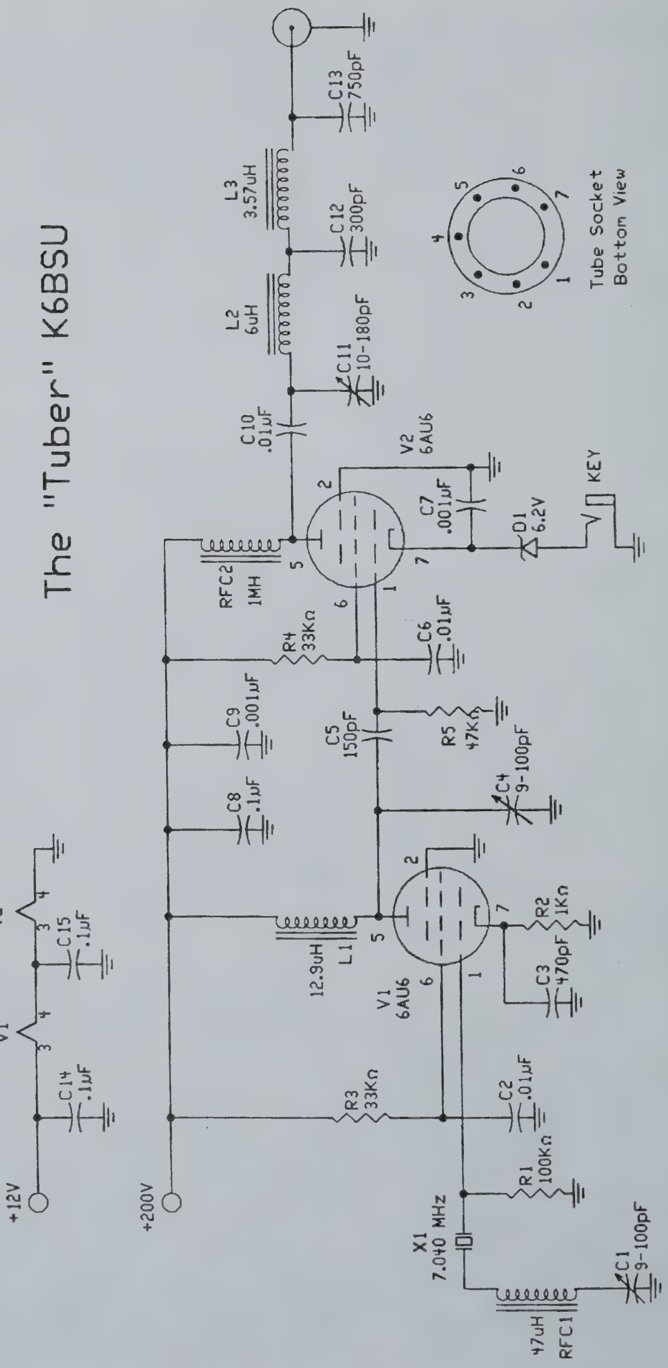
T1 EA77-250 core kit, Amidon Inc.,240 Briggs Ave., Costa Mesa, CA 92626 (714) 850-4667

Winding "A": 300 turns, #30 enameled magnet wire.

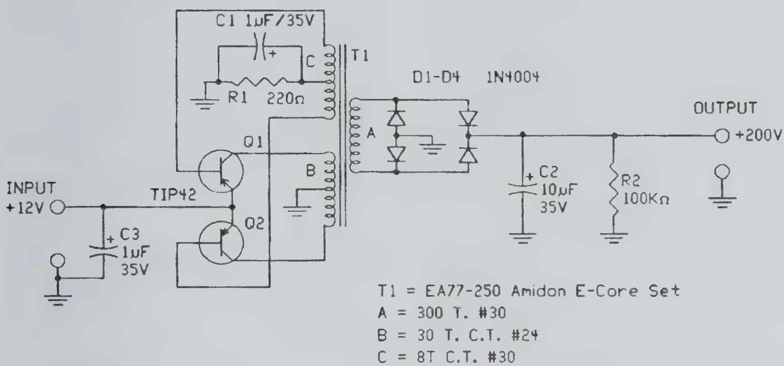
Winding "B": 30 turns center tapped, #24 enameled magnet wire.

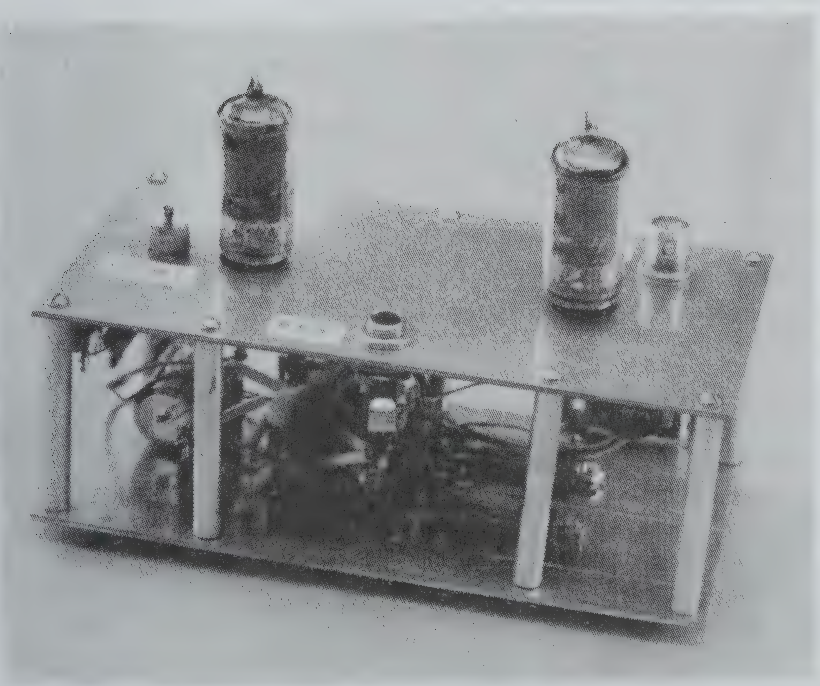
Winding "C": 8 turns center tapped, #30 enameled magnet wire.

The "Tuber" K6BSU



"Tuber" Power Supply





K6BSU "Tuber"

AN NC40A ON STEROIDS

by Gary Surrency, AB7MY
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I've been helping several folks on the QRP-L to increase their NC40A transmitter output power level. This article covers most of the things I've done to mine. There are a number of ways to get the output higher. The ideas I include here have worked well for me, and no hacking of the rig or cutting of traces in necessary.

The most increase in power I got with my Wilderness NC40A, was when I redid the PA low-pass filter (LPF). The original LPF is set up to operate with a higher collector load impedance for the PA operating at only 2 watts. The PA needs to see a load of about 19 ohms at 13.8V and 5 watts.

*Equation 1, approximation of RF PA operating load impedance:

[R_collector = $(Vcc)^2 / (2 * Pout)$]

or,

R_collector = $(13.8)^2 / (2 * 5)$

R_collector = 19.044 ohms

If you operate strictly from batteries, then an even lower collector load impedance is necessary to get the PA to "work" hard enough to develop 5 watts.

R_collector = $(12.6)^2 / (2 * 5)$

R_collector = 15.876 ohms

As the original NC40A is set up for operation at 2 watts, we get:

R_collector = $(13.8)^2 / (2 * 2)$

R_collector = 47.6 ohms

Or, for operation at 12.6 volts:

R_collector = $(12.6)^2 / (2 * 2)$

R_collector = 39.7 ohms

Get out your MFJ-259B or other antenna analyzer, and hook it up to the antenna BNC jack. Leave the power off to the NC40A, and place a 39 to 47 ohm (or 51 ohm) resistor across the PA C and E leads. Tune to 7.040 MHz or so, and measure the SWR, resistance, and reactance. Then observe at what frequency the match is best. This will confirm how the LPF is actually operating.

As you can see, the original LPF was designed for an input and output of approx. the

same impedance , or 47-50 ohms. We can modify it so that the input impedance is lower than the output impedance, and thus force the PA to work harder. This could also be done with a tapped PA collector choke or transformer. But the PCB layout does not lend itself well to that type of mod, and simply changing the LPF is easier and less damaging than hacking up the PCB.

So let's change the LPF filter components to what I used:

Original Filter		**New Filter**
C45	330pf	470pf
L7	18 turns on a T37-2	16 turns on a T37-2
C46	820	820pf (same cap)
L8	18 turns on a T37-2	19 turns on a T37-2 (or, 18 turns tightly wound)
C47	330 pf	470pf

Note: I used all ceramic caps and still got good results. Silver Mica caps have lower loss, and may gain you a db or so of output. NPO's are about as good and cost less than S/M. The most important thing is to get a good match from the input to the output.

Now put a 15 to 19 ohm resistor (use two 39 ohm 1/4w resistors in parallel, or use a 39 + 33 ohm, in parallel) across the C and E leads of the PA. Again use the antenna analyzer to read the match. Small adjustments to the inductor winding spacing should bring the antenna side match very close to an SWR of 1:1, 49-50 ohms resistance, and zero reactance. A perfect match is possible - but not absolutely necessary - as little difference in RF output will be seen when the match gets close. But try to eliminate the reactance value as much as possible, and center the filter on the desired operating frequency.

The new LPF is now set up correctly for 5 watt operation at 13.8 volts (or whatever other supply voltage and power level you choose with the appropriate equation values).

I retained the original 18uH solenoid choke at RFC1 in the PA collector, as some experiments proved it was just adequate. It barely gets warm at 5 watts output.

BE SURE TO REMOVE THE ANTENNA ANALYZER BEFORE CONNECTING THE DC POWER AND TRANSMITTING!!!!

Changing Q5 to a J310 will

help if the PA drive is low, as does the change of Q6 to a MPS2222A transistor. Or find another, better 2N2222A. Try several different devices and pick the "hottest" ones. Even some good quality 2N3904's will work for Q6.

Be sure that driver transformer T1 is carefully constructed. I rewound mine using #26 red enamel for the primary left over from building my K2. And some #26 green enamel was used for the secondary. Space the 14 turns of the primary around the entire core for 80-85% coverage. Then wind center the secondary windings, so that there are 4 turns of the secondary in the middle of the primary. When you are done, there should be 5 red wires on one side, and 4 red wires on the other side of the secondary. This insures the best transformer operation, and it looks best too. I left the finished core spaced just a little above the PCB, maybe 1/16".

A 220 ohm pot at R13 is a better choice than the original 500 ohm one, and it aids in setting the output level more easily. You could reduce R12 a bit from 20 to 10-15 ohms too, but I did not need to. I also changed the stock one-turn tuning pot to a 10-turn unit some time ago. It really makes the difference!

If the output will still not reach 5 watts, you might have low VFO output. Changing the J309 in the VFO oscillator might help this, as we found out in some NC20 kits. You might even try a J310 there, but it will run hotter with its lower channel resistance (less R_ds_ON), and may increase drift. The J310 I tried also did reduce the VFO tuning range some. With the hand-selected J309 I ultimately used, the tuning range is about 51 KHz.

As a last resort, you can increase the size of capacitor C31 from 5 pf to 6-10 pf. Do not increase the size of this cap very much, as spurious output may increase with excessive VFO drive into the NE602. Without a spectrum analyzer or high quality oscilloscope to look at the signal, it is risky to increase C31 much above 10 pf. These mixers do not like too much signal into their inputs. I used a 10 pf for C31 in mine.

The size of C37 may also be increased from 5 pf to 10 pf. This further increases the signal level into the band-pass filter at Q5's input, and broadens the response of the filter a bit. Previously, the output tended to fall off a little too much at the limits of tuning, depending on what frequency I peaked the filter at. The result is a nice broad filter response – yet the output is still clean and a bit higher. Some 5 pf caps I've measured in the rig were low in value to start with.

At 7 MHz, they don't have a lot of reactance, so if they measure lower than they are branded – you ought to replace them. I used a AADE digital capacitance meter.

I toyed with the idea of using the balanced output of the NE602 into a transformer to gain a bit more output from U4. But I found this was not necessary, and would add unnecessary complexity to the design.

If your TX-derived sidetone is too loud or raspy, the increased power level from the transmitter into the receiver input may be reduced by trying another 2N4124A at Q1, and/or insuring that the AGC threshold is set correctly and Q2-Q3 and their associated components are working properly. My sidetone is not loud or distorted at 5w. I still have the 8.2 M resistor at R4.

With the PA LPF properly adjusted, there is no need to change the zener diode at D12, since the lower PA collector load impedance prevents the peak collector voltage from exceeding the original zener's voltage rating. It should not get warm, and the lower voltage helps protect the PA device better on brief antenna mismatches. But it will not save the PA from bad loads at full output. Be forewarned, as I have been there and done that, as Chuck says. Use an antenna analyzer to pre-set the antenna tuner, or something like the ZM-2 that has a built-in resistive SWR bridge for some degree of protection during tune ups. I can't say enough good things about the ZM-2!

With all these "blueprinting' mods done to my NC40A, I can actually reach 7 watts with a 14.0v DC supply. Since the MRF237 is used is rather small, I play it safe and stay at 5 watts or below. Avoid long key down periods, and heat sink the PA well by putting the MRF237 under the PCB with its case (at ground potential) thermally greased and pressed against the bottom cover. I just started using this method on my rig, and it seems to be the way to go. The PA device runs cooler this way, and there's no worry about overheating as there is with almost any size of TO-5 / TO-39 finned heat sink you can find.

Or, you can put a *large* TO-5 heat sink on the PA mounted conventionally on the top of the PCB, such as the NTE401. Tip: bring along a spare PA transistor on camping trips and use IC socket pins for a quick-change PA, especially if you run the full 5 watts and you're careless about antenna matching. Be sure the heat sink used does not cause the PA to fall out when you transport the rig if you do socket it.

Some of these mods have appeared on the QRP-L before,

in my postings about low-pass filters and about increasing the output of the Small Wonder Labs SW-30 and SW40 series. The DL-QRP PA module is another option. But these mods require the least modifications to the NC40A, and they can all be undone with no lasting damage to the original design, should you want to sell the NC40A later.

I chose to not incorporate another larger case style PA device such as the MRF476 in a TO-220 package, as I did not like the mechanics of different PA mounting and heat sink options. 5 watts is about all you can expect of a PA in a TO-39 or TO-5 package. The rig's PA *is* fragile at that power level since the breakdown voltage ratings are low and the case thermal resistance is high. And, the TX stages (U4, Q5, Q6) ahead of the PA are not suitable for much greater drive to any single PA device. In other words, these mods produce about the best compromise of power output and least circuit changes, given the original, excellent design. More power would also tend to upset the RX too much without re-designing the T/R circuit.

PA devices designed for operation at 13.8 volts *are* more efficient than ones designed for operation at 28 volts in this application. But they are also more fragile, and easier to destroy with high SWR. The 2N3553 is a pretty good 28 V device, if your NC40A already has one. The 2SC799 is not as rugged, and will not go much more than 3-4 watts without expiring. The MRF237 and 2N3924 **are** designed for 13.6 V operation, and are best in this rig, but they are getting harder to find and are more expensive.

The 2N3924 is a bit more fragile than the MRF237, but it will do 5 watts plus and has the same EBC pin out as the 2SC799 and 2N3553. The MRF237 is easier to find, and will do 5 watts easily. But it really needs to be mounted upside down under the PCB and heatsinked to the bottom cover. It's reversed C and E leads make this possible. The case is connected to the emitter, which is grounded, so there's no need to insulate the case from the bottom cover. I haven't yet removed the paint from the bottom cover where the MRF237 is located, but it does not seem to overheat as best as I can tell. I might sandblast off the paint in the spot where the MRF237 sits one day if this one ever fails. So far so good. A very small top hat style TO-39 / TO-5 heatsink would help remove heat from the sides of the device, and might still fit under the PCB and against the painted bottom cover for better heat transfer.

Push-pull PA designs such as the one from the DL-QRP

club are more complex and not nearly as current efficient as the single class C PA stage used in this and most QRP rigs. But that PA is a very nice unit and I may have to get one just to play with!

Hopefully this info will help you and others that like the NC40 and just want more output for tough conditions or poor (not mismatched) antennas. Mine works well, and has been tweaked about as far as it will go!

*Reference: Solid State Design for the Radio Amateur, Copyright 1986 by ARRL, page 61.

The Time for Surface Mount Projects Is Now!!

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[Reprinted with permission from QRP Homebrewer, Journal of the NJ QRP Club, Winter 1999)

NorCal QRP Club has done over 10,000 kits since we started the club backin 1993. I have sourced the parts on every one of those kits, and I have noticed a disturbing trend, it is getting harder and harder to find through hole, or leaded parts. The sources are just drying up. One of the companies that I do business with in the bay area does millions of dollars in the surplus parts business every year. The owner of that company told me recently that as recently as 5 years ago, he would get pallets of through hole parts, all that he needed. It is a much different story today. He told me that now he will get through hole parts in only one pallet out of ten, and that may only be a box or two in the whole pallet. We have to face it, through hole parts are getting harder and harder to find. Plus, all of the new chips are being designed in surface mount. Since our economy operates under a supply and demand pricing system, the cost of these parts is going to go one direction, higher. Soon through hole parts will be like tubes are today. It is already starting. I used to pay 25 cents for a 2SC799 RF transistor, now, if you can find them they are \$2.50 - \$3 each!!

What are we to do? We love to build, but one of the advantages of building is that you usually get a better radio cheaper. If the parts cost are going to go up 10 times or more, soon that will not be the case. We only have one choice, we must go to surface mount parts, which are

currently in production in mass quantities world wide. That is the secret of cheap parts. Find something that is massed produced, and it will be much, much cheaper than things produced in small quantities, the old supply and demand theory.

Recently someone posted on QRP-L that we need to move out of the dark ages and start working with surface mount. The only surface mount kits that have been done in the past seven years, that I know of, are the TiCK Keyer by Embedded Research, and the SMITE, which was a surface mount version of the Pixie done by Bob Kellogg and the Knight Lights, a group of QRPers in the Carolinas. The TiCK is a simple kit with only 4 or 5 surface mount parts. The SMITE, while selling over 700 kits, was a very basic transceiver, and it is no longer being offered. I had talked with one of our designers about doing the next NorCal kit last fall. We wanted to offer something on 10 meters, but with a built in Keyer, DDS VFO, RIT etc. A full featured rig, but we wanted to do it for $50. The designer suggested doing it surface mount, and I immediately agreed. We would have the fine pitch chips premounted and tested, but the rest of the parts would be surface mount where possible. That kit is in development now, and we hope to see a working prototype by the first of May. Sorry, I can't reveal the designer at this time, as he prefers to not be deluged with email and questions about the new kit. Once the kit has been done for 10 meters, there will be versions done for 12, 15, 17 & 20 meters, but not by NorCal. Those will be commercial products.

When I announced the new NorCal kit on QRP-L, the response was huge. I got over 200 messages of encouragement on the project. I also got 3 messages telling me that it would never work, one even posted to the list a long message on how it was not necessary to go to surface mount parts. I obviously disagree. Another thing that was a recurring theme in many of the messages was that people wanted to have a kit that was an intermediate step between now and when the "full featured" NorCal 10 meter kit comes out.

I thought about this, and my first thought was to do the Tuna Tin 2 surface mount. I even layed out a board for it. Then I thought better about it. George Heron and the NJ QRP Club is already doing that kit, why compete with it?? It would be redundant. But I wanted something simple to do. Then I remembered Pacificon and the simple Tuna Tin 2/MRX Receiver kits that we did. Guys loved them and several did many modifications, including Dave Fifield, AD6A, of Red Hot Radio

and NorCal 20 fame. Dave had put his mods on his web page. I got on the internet and went to the Red Hot Radio site at www.redhotradio.com. There it was, under TT2/MRX Mods. Dave listed the following specs for the rig after he did his mods:

- 500mW output into 50 Ohms (clean enough now)
- TX frequency variable from 7040.55 to 7042.03KHz
- varicap tuned (1.48KHz range)
- TX output envelope wave shaped
- Very little TX chirp (still a tiny bit, but I'm working on it!)
- RX tunes 7038.47 to 7042.72KHz (4.25KHz range)
- RX can hear -120dBm signals
- Full electronic QSK- No relays, no switches
- No thump!!!- Real sidetone (clean sine wave)

This would be a perfect candidate. I took a quick look at the parts, and there didn't seem to be anything esoteric in there. Wait a minute. It used an LM380-8 as an audio amplifier. I checked and that part is not available surface mount. But the LM386 is, and I knew that Dave could make the substitution with no trouble. This was on a Friday night. I called Dave, suggested that we meet for lunch the next day in San Jose at St. John's Bar and Grill, one of our favorite restaurants.

My plan was to ask Dave if it would be very hard to do his version of the TT2/MRX with mods surface mount, and change the audio amp to an LM386. I would need his help, as he is an expert at laying out boards, and that is critical with transceiver design. The timing could not have been better. Dave agrees that we need to move to surface mount construction, but that we need to do it slowly, and in steps that are not so big that the average builder can't do the kits. He also plans to move to surface mount with his future Red Hot Radio kits, and welcomed the opportunity to learn about surface mount board layout. So it was a win – win situation. Dave would get the chance to learn, and NorCal would get expert assistance with board layout. The design was proven to work, so that would save a huge amount of time. It didn't involve a large amount of parts, only about 85, so it would be a simple kit. The only thing was to swap the LM386 in and the LM380 out, a simple matter for Dave Fifield.

We left the restaurant and went to Dave's house where we started the project. The first thing that we had to do was to determine what size parts that we were going to use. Surface mount resistors and capacitors

come in several sizes, all referenced in thousandths of an inch. The largest size are called 1206's and are 12 thousandths by 6 thousandths of an inch in size. The next size is the 805 class, which are 8 thousandths by 5 thousandths. There are also 603's and 402's. Dave works in Silicon Valley as an engineer. His company designs and manufactures products using surface mount technology. There is currently a 52 week lead time on certain values of capacitors in the 805 and smaller surface mount parts. But, there is a good supply of 1206 sized parts. This was perfect for us. The 1206's are the biggest and easiest to work with, and they are currently available, with no lead time!! We would go with the 1206 size.

Dave started laying out the board, while I searched catalogs for parts and package information. Three hours later we had located a source for every part description, and he had the package information that he needed to do the layout. I left to drive home, and when I arrived there 2 hours later, Dave called to say that he had the preliminary board done, and that it was 2.5" x 2.25" with the three control pots board mounted on the front edge of the board. Wow, quick work. Dave spent the rest of the weekend checking the layout, and sent it off to AP Circuits in Canada to get a couple of prototype boards made. He ordered parts in small quantities to do the prototypes on Monday. The boards came in on Wednesday, Dave built and tested the prototype Thursday evening, and made his first qso on Friday! Total time from conception of the idea to working prototype, 1 week!! Dave Fifield is amazing.

George Heron of the NJ QRP club is a very good friend of mine, and we work closely together helping each other with NorCal and NJ club matters. We talk weekly on the phone, and have wanted to do a kit together for some time. But there were problems. We both use volunteer labor, and sometimes they don't get the work done as fast as it needs to be. How could we do a project together, yet be independent of each other? George solved the problem. I called him and mentioned that we were going to do the surface mount interim kit, and that we would call it the SMK-1. It would be a board and parts only kit. The light went on in George's mind, and he suggested that the NJ club do the case and connector kit!! Brilliant idea. I sent George measurements and locations for the holes for the front mounted controls. He and his people very quickly came up with a custom designed case and all of the rest of the parts needed to complete the SMK-1.

NJ would supply a case kit made from PC Board soldered together, the 1/8" phone jack, the 1/8" key jack, the coaxial power jack, and the BNC antenna jack. They would also supply the screws and feet for the case, plus the knobs for the pots!!

This was a huge help to us here at NorCal. We did not have to worry about the case!! The labor for doing that would be done by the NJ club. Another first for NJ QRP and NorCal. Two clubs working together to produce a kit, and the big winners are the QRPErs!! This is exactly the role that clubs should be playing. The purpose of NJ QRP and NorCal are the same. We both want to do everything possible to enhance and promote QRP. We want to encourage building. We want people to learn how to do surface mount construction with a simple, easy to build kit, using the easiest to use surface mount parts. We believe in starting with the basics, and then going forward once we have the basics down.

The SMK-1 kit is a perfect first time surface mount kit. It has 85 parts, and all but the 3 control pots, two crystals, and the two trimcaps are surface mount!! There are IC's in the easy to do SOIC package (50 mil spacing, which is half that of a normal IC), transistors, diodes, resistors, capacitors, inductors, in short all of the normal parts needed to build a radio. The size of the parts is not that small. The only special equipment you will need is a fine tipped soldering iron, a pair of tweezers, and eye magnification if you need it. The prototype was built by Dave without any magnification at all.

We are excited about this kit. It is a step into the unknown. We have had to come up with a system of packaging the parts so that they can easily be identified. What we came up with is that we will use a 3" x 6" bag and we will do 2 seals on it length wise. That will make 3 sections in the bag, 1" x 6". We will put parts in each section, and then seal it, to make a row of sealed parts across the bottom. Then we will put the next set of parts in the tubes, seal, etc. When we finish, we will have a bag that has been divided into 21 parts, with a component sealed in each section. The manual will have a "key" that is a matching diagram with the parts listed on the diagram. All that the builder will have to do is lay the bag over the diagram with the "key" in the proper place, and then he will be able to identify the parts. Very simple. That is why it works.

I must say that the sourcing of parts for the SMK-1 was the easiest kit that I have ever done. I found all of the parts and ordered them in ONE DAY!! By comparison, it took several weeks to do the NC20. The rea-

son is simple. We are using surface mount parts.

If you'd like to order an SMK-1 please send a check for $34 ($30 for the kit plus $4 for shipping and handling US & Canada, $6 Europe and $8 Pacific rim) made payable to Jim Cates and send it to:

Jim Cates
3241 Eastwood Rd.
Sacramento, CA 95821

Please include a self addressed mailing label. It can be simply your name and address typed on white paper.

If you would like to order a custom designed matching case and all parts needed to finish your SMK-1, then do the following:

The SMK-1 Enclosure Kit

The NJ-QRP Club is pleased to offer another "first" for the QRP community: a homebrew enclosure kit made entirely from double-sided copper-clad pcb material. Working closely with NorCal in the introduction of their SMK-1 transceiver, we designed an enclosure tailored to the small-sized SMK-1 and created a kit of all parts needed to finish off this surface mount transceiver.

Included in the SMK-1 Enclosure Kit ...

8 precision-cut, pre-drilled copper-clad pc boards which, when soldered together as instructed, form the enclosure to hold the SMK-1 Surface Mount Transceiver kit from NorCal.

3 knobs (for the pots included on the SMK-1 pcb from NorCal)

Rear panel hardware: two 1/8" audio jacks, a 2.1mm coaxial DC power jack, and a BNC connector;

2 small screws to hold the top half of the case to the bottom;

4 small screws and two nylon spacers to hold the SMK-1 pcb in place;

4 rubber feet

Pre-printed front and rear panel labels on clear acetate, suitable for gluing to the enclosure to give it a professionally finished appearance.

A 10-page, detailed instruction manual to guide the QRP homebrewer through construction and finishing of the SMK-1 Enclosure.

Price and Ordering for the SMK-1 Enclosure Kit

The SMK-1 Enclosure can be purchased for $10 from the NJ-QRP Club. This price includes shipping anywhere in the world. Send cash, check or Money Order payable to "George Heron, N2APB" and mail to:

George Heron, N2APB
2419 Feather Mae Court
Forest Hill, MD 21050

Conclusion:

We plan on offering this kit for at least 1 year, in order that all will have an opportunity to build with surface mount.

One final thought. Don't be afraid to try surface mount. You can do it!! There will be tons of people available to help you through any problem areas, and together we will make you successful.

As a followup, we have shipped over 400 kits and everyone has been able to build it. We have no reports of failures!! Guys are having tons of fun, and we have proven that Hams can and will build with surface mount. The Great SMK-1 experiment is a huge success. Again, we are still shipping this kit. It is intended as a beginner's course in working with surface mount components, not as a full featured 40 meter transceiver. The interesting thing is that many, many guys are reporting great success making contacts with the SMK-1. 72, Doug, KI6DS

15 Meter Pad and Glue SST

by Mike Fitzgibbon KI0AF

[Reprinted with permission from the Iowa QRP Club Newsletter, Spring 1999)

The SST is a popular little minimalist-type transceiver with a surprising performance level, considering the parts count. Once again, Wayne Burdick, N6KR, did a great design/development job on the little rig. It is no wonder that the Wilderness Radio kit versions for 40, 30, and 20M have been quite a success. The kit has, however, never been offered for the 15M band.

Although a conversion of the 20M kit to 15M is easily accomplished, I wanted to incorporate a few "enhanced-performance" modifications (most of which were gleaned from posts to the Internet QRP-L list) into an easily built, ugly-style version for the 15 M band. Some of these enhancements include: three-turn tuning pot, increased tuning range utilizing two varactors, increased RF power out using an MRF-237 final, adjustable transmit-sidetone level, and an integrated single-chip keyer. What follows is a brief but hopefully useful description of this process...a task easily undertaken by anyone with a few ordinary test instruments, some hand tools, a little soldering experience, and the desire to work the world on a watt or two with a completely homebrew rig.

Start by getting a copy of the original construction article (spring '97 issue of "QRPp"—NORCAL's quarterly publication-see parts below) and/or copy of the kit instructions, if possible. You will see that the heterodyne scheme of a 15 M. version sim-

ply uses a 25.0 MHz VXO (instead of an 18 MHz VXO as in the 20 M version) mixed with the 3.932 MHz IF (same as 20M version) to get you "there". The rig I built using two varactors tunes from 21.051-068 with a little overlap, and is dead stable.

The VXO and IF/BFO/transmit mixer crystals can be ordered from Digi-Key (see parts list) and the filter crystals matched using a simple crystal-checker circuit such as the one on page 25-6 of the '95 Handbook (a copy of the schematic is available from the ARRL). I used this circuit (just a couple of 2N2222s) with an inexpensive handheld frequency counter (Optoelectronics 2810) to measure and match the three crystals for the filter. Out of the twenty IF crystals in the purchased lot, no less than four sets of three crystals were found to lie within 20 hertz of one another...making for some very fine Cohn filters when used with high-Q (read "mica" or "ceramic disc") capacitors. The remaining crystals were close enough to all be used in the BFO and transmit mixer with no problems. I cannot in good conscience guarantee that you will certainly have this good fortune buying closely-matched crystals, but similar results have been obtained a couple of times since with small lots from both Digi-Key and Mouser Electronics. I will venture a guess— that if the crystals come out of the same box/batch it would appear that many may be quite closely matched at these frequencies (around 4 MHz). You have to take a little chance here... Throw in with a friend and buy 20 or so and see what you get...I have not been sorry yet, and there are four (40, 30, 20, 15 M) homebrewed SSTs sitting on the shelf...and the filters sound and work fine.

The construction method utilized consisted of 3/16" pads punched from single-sided PC board using an inexpensive sheet-metal punch available from a discount mail-order house (see parts list below). The punch comes with dies for holes/pads from 1/8" to 7/16" or so. The 3/16" size seemed to be about right for my purposes here and most other circuits as well. Ordinary household super-glue is used to secure the pads to the copper side of the circuit board in what some refer to as the "Manhattan" style of ugly-construction (I prefer to call it "grain-elevator" myself...). A little care must be used to avoid contamination of the copper surface with substances that will lessen the hold of the glue...a swipe of your favorite solvent/cleaner on the board where the pad goes will do. Methanol is my favorite (hardware-paintstripper/solvent). I used the liquid super glue and not the gel type, which seems to take longer to set up. One

small dot of glue will suffice. You have approximately three to five seconds before it sets after the pad is placed... so marking the spot on the board with a pencil AFTER you have trimmed and fitted the part leads and BEFORE the glue is laid ("dotted") is advice strongly recommended. The pads can be removed after the glue is set with a fairly sharp lateral blow, but the glue residue will not leave a pretty or level spot...a little layout planning is also highly recommended.

Once the pad is placed, a pencil eraser seems to make a very good "tool" to push and hold the pad to the copper for the few seconds it takes to set up, after which soldering can immediately take place. This construction method allows one to make quite compact and stable layouts since "grounds" are available everywhere. Try this method by first building the crystal checker on a small 2 x 2 inch or so piece of board to get the "feel" for it...it works great and further mods are simple and easy.

Construction Technique

I used inexpensive low-profile machined-pin IC sockets throughout, including the keyern board. The pins are a bit longer than those of a leaf-type socket, and can be easily bent 90 degrees or so outward away from the socket (bent about ONCE, although the pins will rotate before the IC is inserted). These sockets, unlike some leaf types, do not soak up any solder, and their cost is minimal at around 20-30 cents in small quantities (see parts list). I use this type of socket exclusively in my projects now...they are also sturdier as a general rule. After bending the pins outward at 90 degrees or so away from the socket center the socket can be mounted by simply soldering the bent-out pins to the pads at three or four corners. Unused pins can be removed with wire snips or a cut-off wheel mounted on a Dremel tool. Grounded pins are now just long enough to reach the board if left unbent. Also, the use of small gauge, tinned buss wire (20-24 gage) is a painless way to make many of those needed connections. Additionally, connections may be made by running wire underneath the IC sockets if necessary since there is a little bit of room there too. Most of the parts used here were from the usual sources, with a healthy dose of surplus parts from Dan's Small Parts. I used quite a few parts from Dan's which were on sale and collected as just general QRP- type parts over a period of several months while watching his website for bargains. Consequently, the cost of the rig was held fairly low in my particular case. The 15 M-specific and modification parts

are listed below, and the remainder can be found by part number and supplier in the kit instructions, if you happen to have a copy.

The layout of parts is not particularly sensitive, although a few general guidelines are worthy of consideration. The receiver section should be located near the front panel to minimize lead length from U1 to R1 (the RF attenuator) if you so choose to locate R1 on the front panel. Likewise with the VXO circuit, mount it at the front of the board to keep the leads to the varactor switch as short as possible—millimeters DO count here. The varactors are mounted on the top and bottom of a DPDT mini-toggle switch so that the "up" position is the higher range and vice-versa. This means that the MVAM108 will be mounted on the topside of the switch. Keep all of the VXO parts leads short also.

The general layout uses as few jumpers as possible, the necessary wires including the control and input/output leads and a few runs of RG-174 from the VXO to the transmit mixer, the receiver mixer, and antenna jack. The ICs are powered by jumpers which run from the 78L08 regulator which might be located near the edge of the board to provide easy access due to the number of runs necessary. The 386 audio amp can be powered directly off the DC input and through a 100 ohm resistor for a little more gain on audio peaks (hardly noticeable though).

The keyer board was mounted to the back panel and the peizo transducer for the keyer was mounted on the inside of the bottom of the enclosure near the front, under the board which was placed on quarter-inch standoffs.

The circuit can be built one IC at a time, while laying out the larger parts on the board for fitting before the pads are glued. Start with the regulator parts and then go on to the VXO. You can monitor the signal on your station's main transceiver to get it going.

Modifications to the original circuit were made to increase the transmitter output. These include the MRF-237 final, adding a 2.2uH choke between the final's base and ground, changing R10 from 180 to 120 ohms and, of course, increasing the DC input. I have seen over six watts output on my 'brewed 20 M version when I had a slight (!) power supply accident-a shorted voltage-adjustment pot in the power supply resulted in 25 volts going to the rig. The 237 final got VERY hot but it took the lickin' and kept on tickin'-although I don't recommend you try this much voltage unless you are very adventuresome, have a large heatsink, and some spare

parts... With these mods the rig puts out 2.5 watts at 13.8 V. and about 2.25 watts on a good gelcell into a reasonable load.

Also included in the mod list is the addition of two J305 FETs in the audio line which allow adjustment of the transmit sidetone (actually transmit monitoring). I found the level of the sidetone to be a little on the hearty side for my liking when it was necessary for the gain to be turned up at or near max. You can, of course, turn down the volume every time you transmit, or you can make this easy modification and use a 5 megohm trimmer to set the level to your fancy...it goes as follows: Place the FETs in the audio chain directly after the mixer (U2). They are in parallel, with one FET in each of the lines from pins four and five with the source leads toward U2 and drain leads on to C12 and C13. Tie their gates together and run a 2.2 megohm resistor from one (either) of the source leads to the now joined gates. This will hold the FETs open and conducting the audio signal thru the FETs as long as the rig is not keyed. Also place a .1uF cap from the gates to ground. Run a 5 meg trimmer across the source to drain leads of one of the J305s (again, either one) to "leak" a little of the signal around and past one of the FETs when they are grounded (and shut off) by the activated keyline. Then put a 1N914 diode and 1000 ohm resistor in series running to the keyline with the non-banded end of the diode connected to the joined drains and the resistor running on to the keyline. Adjust the level via the trimmer to your liking.

This mod came directly from a post by Wayne B. and works FB, although it does slow down the QSK by a smidgen. You probably won't notice it much unless you're running over 35 WPM QSK.

One other substitution to the original circuit was made to allow precise adjustment of the BFO and transmit mixer. Two 60 pF trimmers were used at C10 and C24 instead of the fixed-value type. This will let you to adjust the BFO and transmit-offset "right on the nose". These can be the same value/type trimmers as C1 and C28.

One other thing worthy of mention—If you do use a multi-turn pot for tuning, you will find the lack of an RIT circuit perhaps a bit less noticeable since it is now considerably easier to return to the same spot on the dial before transmitting. This is due to the fact that the band is now more "spread-out" and the exact position of the tuning knob now a bit less critical, making it much easier to "eyeball" it back to where it was before. You can also use a pencil, marker, etc. to make a line at this spot to re-

turn to, especially if you use a natural aluminum enclosure, from which any marks are easily removed with an eraser, solvent, etc.

As for board and enclosure size, the first SST built here (40 M) was considered a prototype (ain't they all?) and was assembled on a single-sided board 3 x 4 inches placed in a 5 x 4 x 3 Bud mini-box (-3005A, from Mouser). In this size of enclosure a pack of 8-10 AA batteries could easily be added. Subsequent models were built on 4 x 2.5 inch boards and mounted in 5.25 x 3 x 2.13 inch mini-boxes (-3006A) with considerably less room to spare.

Although the pad-and-glue construction method generally allows for very easy building and modification, this smaller board size made it occasionally necessary to remove a part or two just to get to the desired pad if it is necessary to go back and change something once the majority of parts had been mounted in a particular area. The iron used was an ordinary Weller WP30 with an ST1 tip. The board material came from the scrap bin at Surplus Sales of Nebraska. No copper ever came lose from the pads, even after repeated heating with this iron. It is certainly a simple, sturdy construction method, easily subject to individual "customizing" if desired. Parts can be mounted both horizontally and vertically, as connections between ICs, and stacked... you can just go nuts!

Additionally, a pair of 5-6 inch forceps (also known as "hemostats" in the medical world) are invaluable in building with this method. If you lock the part in the forceps by a lead it can now be handled much more readily and held in the tightest of spots for soldering. Radio Shack sells these for around $6-7, although the two pair I have purchased over the years from them don't seem to be of very high quality and I don't recommend those in particular. Electronic supply houses usually have these in the handtool section.

The keyer board can also be constructed using this same technique, employing your favorite flavor of keyer chip. In all versions built here it mounted easily on one side of the rear panel if all the in/out connectors are sized small enough and located on the other half of the rear panel. I used a BNC connector and 1/8 inch jacks, with a power jack similar to the type found on many of the popular QRP kits. These are available from Mouser in several styles with matching cords/plugs. PARTS:

(plus $4 postage) and includes four issues in the volume—spring, summer, fall, winter. Make payment out to Doug Hendricks. The SST construction article is in the spring 1997 issue. There is a wealth of QRP info in each issue and it is WELL WORTH the bucks.

Hand punch for pads— Stock no. 37405-3NJH — $16.99 phone orders: (800) 423-2567 http://www.harborfreight.com

Crystals-15 M. VXO: 25.0 MHz, Digi-Key (see below) stock no. CTX093-ND

IF: 3.932 MHz, Digi-Key, stock no. X013-ND

L2, L3-11 turns of #26 on T37-6 (yellow core)

C34, C36-150 pF silver mica

C35-270 pF silver mica

L1-18 turns of #26 T37-6

C27-30 pF ceramic NPO

RFC3—27 turns #26 on T37-2 (red core) — this may have to be varied, depending on the circuit and the tuning range desired-start with 28-30 turns

MRF-237*-about $9, available from RF Parts, 435 S. Pacific St., San Marcos, CA 92096 phone orders: (800) 737-2787 E-mail: rfp@rfparts.com *note on MRF-237: the collector and emitter leads are reversed on this device, compared to the normal pin-out of the standard TO-5 package -install it backwards and IT WILL FRY! Use healthy heatsink.

three-turn potentiometer: Spectrol 533, 10K, stock no. 970-1830, $12 from Allied Electronics, below

low-profile machined-pin IC sockets (8 pin): stock no. 151-308SGT, from Mouser, see below

Electronic Suppliers:

Digi-Key: (800) 344-4539, http://.www.digikey.com

Mouser Electronics: (800) 346-6873, http://www.sales@mouser.com

Dan's Small Parts and Kits: Box 3634, Missoula, MT 59806-3636, phone/fax: (406) 258-2782 http://www.fix.net/~jparker/dans.html

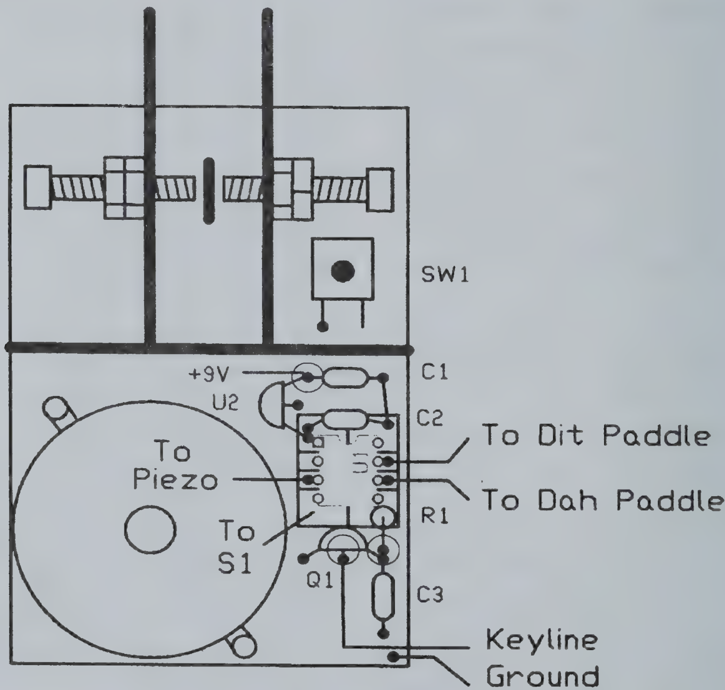
Allied Electronics orders (800) 433-5700 http://www.allied.avnet.com

TICK keyer kits/ICs: Embedded Research, PO Box 92492, Rochester, NY 14692 http://www.frontiernet.net/~embres

72, de Mike KI0AF

The Fort Smith QRP Group P-TiCK Kit

by Doug Hendricks, KI6DS
ki6ds@hotmail.com



One of the up and coming QRP Clubs is the Fort Smith QRP Group. Last year they kitted the VE3DNL, and sold enough kits to put on an outstanding QRP Forum in April in Ft. Smith. They flew in the following speakers, Dave Gauding, NF0R, Doug Hendricks, KI6DS, Paul Harden NA5N, Jim Duffey, KK6MC, and Mr. VE3DNL himself, Glen Leinweber. It was an outstanding event and one that you will want to put on your calender to attend next year. Jay Bromley, the leader of the group, asked me to come up with another kit for them to sell this year and provide funds for ArkieCon 2001. By the way, ArkieCon has absolutely no connection to ARCI The profits from this kit go towards the expenses of putting on the Ft. Smith Qrp Forum held every spring in Ft. Smith, Arkansas. I designed this kit with the idea being to produce a cheap, inexpensive paddle and keyer in the same package. The keyer part was easy, the TiCK from Embedded Research, naturally, but the hard part was the

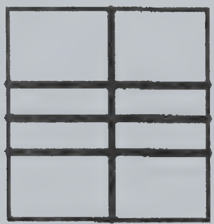
paddles. I actually got the idea from seeing a paddle kit that was on the NorCal page designed by Wayne McFee, NB6M, and from a Manhattan style TiCK keyer that was built by Mike Fitzgibbon, N0MF in one of his homebrew rigs. I decided to change the single lever paddles to iambic and to put the TiCK keyer on the same board, and design it to fit into an Altoids tin. I succeeded, and we have a kit. The amazing thing is that the Ft. Smith QRP Group is selling a kit of parts to build the P-TiCK for $10!! And that includes the TiCK-1 keyer chip. All parts, even the pcboard parts are precut for you. All you have to do is build it. This is a huge bargain, and it is a fun kit to build. Here are the details in case you want to roll your own, but I really think it is far easier to order the kit, plus you are supporting qrp.

Parts List:
PC Board Parts:
1 Base - 2" x 3"
2 Paddle Arms - 1/2" x 2"
1 Fence - 5/8" x 2"
1 Post - 3/8" x 5/8"
1 IC Carrier Pad - 5/8" x 5/8"
Hardware:
2 x 5/8" x 4-40 Stainless Steel Socket Head Screws
2 x ¼" x 4-40 Zinc Screws
6 x 4-40 Brass Nut
2 rubber feet for paddle handles
TiCK Keyer Parts:
1 TicK Keyer IC, (8 pin DIP)
1 8 pin IC Socket
2 1uF tantalum or electrolytic capacitors
1 0.01 mono ceramic capacitor
1 4.7K resistor
1 2N2222 transistor
1 78LO5 Voltage Regulator
30" 3 conductor computer ribbon cable
1 9V Battery Connector
1 Piezo
1 Switch

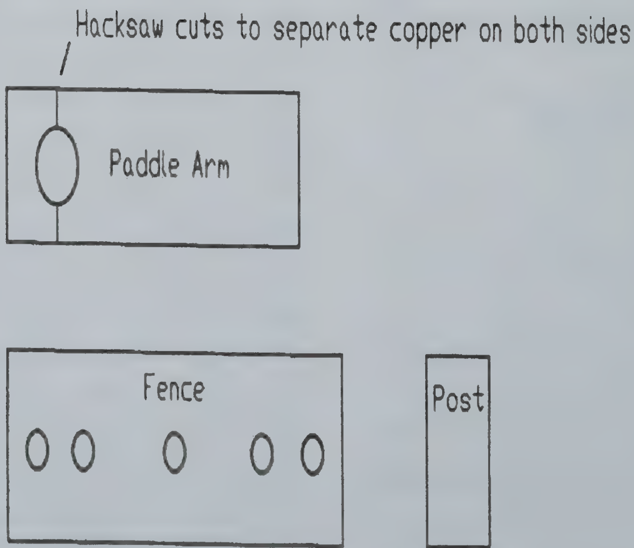
Construction: The kit includes all of the parts needed to build the paddles and the keyer. We will build the paddles first. You need a good soldering iron, with a chisel type tip that is 25 to 30 watts. Here is a diagram of the paddle kit parts.
You have a base, two paddle arms (not drilled), one fence (not drilled), one post, and one IC carrier board.
The first step is to make the cuts in the 5/8" x 5/8" IC carrier board with a hacksaw. Put the square piece (5/8" x 5/8") into a vise so that it is held by the edges, flat side is up, and gently close the vise to hold it. Make sure that you don't bend the board. Use the hack saw to gently cut just through the copper right in the middle of the board. Then turn the board 90 degrees and make another cut in the middle of the board. You will now have a board divided into 4 equal parts. Take the machine pin IC socket out of the parts bag and use it as a

.1" ruler to mark your next two cuts. Make a mark .1" on each side of the center cut as shown in the diagram. Be sure to cut very gently, and just go through the board. The idea is that you are making pads to solder the IC socket to. When you are finished, take an ohm meter and make sure that all of the pads are separate, and that there are no shorts between pads. The next step is to solder the IC socket on the board that you have created. Line up the pins, and solder one corner, then the opposite corner, then the third and finally the last. Then solder the inside pins. Be careful here. If you apply too much heat you will melt the socket. Be quick, yet make sure you have good solder joints.

You might be tempted to not use the socket, but it is important that you do, as it will allow



IC Carrier Board



you to upgrade your keyer to one with a memory should you choose to do so. The machine pin sockets give extra stability and were chosen because of this. When you finish soldering the socket, set it aside for now.

Next we will build the paddle portion of the kit. It is easy to do and the secret is to use enough heat to get good solder joints.

Step 1: Find the post, which is a 3/8" x 5/8" piece of double sided pcboard. Use the special silver solder that was in your kit and use it to put a "blob of solder" on each side of the post. The special silver solder will give you better contacts than the normal solder you usually use. Run a nice bead from the top to the bottom of the post. The post will be soldered so that the base is 3/8" wide and it is 5/8" tall.

Step 2: Solder the post to the main board putting it right in the middle and about ¼" in from the edge. Make sure that it is straight. Run a bead on both sides of the board. Set the main board assembly aside.

Step 3: It is time to drill the access holes for the cables in the fence. You will note in the drawing on page 1 that the fence has 5 holes drilled in it. Use a 1/8" bit and drill the five holes as indicated in the drawing. Be careful and use a set of pliers to hold the piece as you drill it so you won't be injured if the bit catches the board and causes it to spin. Finish up by using a ¼" drill bit to deburr the holes by hand.

Step 4: After you have drilled the holes, it is time to prepare the paddle arms for assembly. There will be two holes in each paddle arm, and we will drill the first one now. Find the center of the paddle and draw a line the length of the paddle arm through the center. Measure 5/16" from one end and put a mark. This is the location of the big hole. Drill it out first using a 1/8" drill bit, then use a ¼" bit to finish the hole. Be careful and hold the pcboard with a pair of pliers, not your bare hands, in case the bit "grabs" the board. Drill the other paddle arm as you did the first. Take a hacksaw and very gently make the cuts shown in the diagram on page two. The purpose is to separate the rest of the paddle arm from the base. Make the cuts on both sides of the hole. Now flip the arm over and do the other side of the arm. Now do the other arm in the same manner.

Step 5: Now it is time to solder the paddle arms to the fence. To do this, you will need a small "C" clamp and a ½" nut . Go to any hardware store and buy 1 nut. Make sure that it is not only

½" in size but that it is ½" in thickness too. You will be using the nut as a spacer to set the distance between the paddle arms and to keep them parallel. Take each arm and put them on either side of the nut so that the arms cover the hole in the nut. Then use the "C" clamp to hold them while you check to make sure that they are square and even. This is very important to the proper alignment of the paddles. When you are sure that the arms are even and square, place them in position on the base that you soldered the post to and check for alignment. If you have the post exactly in the center, the arms will also be in the center. Solder them to the fence so that they are equal distance from the post. Also, make sure that one edge of the arms are even with the edge of the fence. This will be the top of the paddles when you mount it. The fence is 5/8" wide and the paddle arms are ½' wide, this was done to give you 1/8" of clearance with the paddles.

Step 6: Next we will drill the second set of holes in the paddle arms for the contacts. Set the fence/paddle arm assembly on the base and line it up. Let the handles stick over the edge by ½". Mark the paddle arm where it is in the middle of the post. This is where you will drill a 1/8" hole for the contacts. Put the ½" nut back in between the arms so that it will help support the arms, and use a drill press to drill the hole. It will make sure that the two contact screws line up properly. You can drill the holes with a hand drill, but make sure that you drill straight and true.

Step 7: Find two of the 4-40 brass nuts and a stainless steel contact screw, the 4-40 x 5/8" screw with the socket head. Mount the screw in the hole you just drilled in the paddle arm using two nuts, one on the outside of the paddle arm and one on the inside. Tighten them finger tight and then solder the outside nut only to the paddle arm. Be careful to not get solder in the threads, and make sure that you use the stainless steel screws provided. Put solder all the way around the nut. Repeat the operation on the other arm.

Step 8. Let's align the paddles and check to make sure that they will fit in an Altoids tin if you wish to store them in one. Set the fence/paddle arm assembly on the base, then put the base in an Altoids tin. The paddle handles should stick over the end of the base by ½". Mark the base where the fence should be. Then draw a line with a square on the base and use it as a guide to solder the fence to the base. Be sure to double

check that every thing is square, and that it will fit in the Altoids tin. Solder both sides of the fence. I usually tack one corner, then the other corner on the same side and check with a square to make sure it is perpendicular to the base. Make any adjustments needed, and then tack the corners on the other side of the fence. When you are certain it is square, then you can finish soldering.

Step 9: Mount the two contact screws in the arms by first putting a brass nut on the screw and then inserting the screw in the soldered nut. The paddle assembly is now finished.

Step 10: Find the piezo. It is the round black thing that looks like a speaker and has two tabs on it for mounting. Use the drawing on page 1 as a guide, and place the piezo where it goes. Line it up, making sure that it does not overlap the edges. Use a pen or pencil to mark the center of each tab, and then drill each hole using a 1/8" drill.

Step 11: Take two 4-40 screws and put them in the holes you drilled from the bottom of the board. Place two 4-40 brass nuts on the screws and hand tighten. Then solder each nut to the top of the board. They will become standoffs to use to mount the piezo later. When the solder cools, remove the screws.

Step 12: Use superglue to glue a round pad where U2 and C1 connect. Tin it with solder. Solder C1, the 1uF tantalum or electrolytic capacitor to the pad and to ground. Make sure that the positive lead of C1 goes to the pad.

Step 13: Solder C2, a 1uF tantalum or electrolytic capacitor to the end of the IC mother board at the end of the IC socket. The positive lead goes to pin 1, the negative to pin 8. Solder a piece of component lead from pin 8 pad to ground as shown.

Step 14: Superglue the IC mother board down in the position shown.

Step 15: Find U2, the 78L08 and solder it in. Orient it as shown on the parts layout. The three leads go to Pin 1 of IC1, ground, and pad 1.

Step 16: Superglue 2 more pads near pins 4 & 5 of the IC pad as shown. Tin them with solder.

Step 17: Solder R1, the 4.7K (yellow-violet-red) to pin 5 pad and the outer pad that you just glued down. It is mounted vertical to save space.

Step 18: Solder C3, the blue .01uF cap to the pad and to

ground as shown.

Step 19: Solder the 2N2222 (may be marked (PN2222, PN2222A, or 2N2222A) transistor in the orientation shown. The left lead goes to ground, the middle lead to the left pad and the right lead to the outer pad.

Step 20: You have a piece of 3 conductor gray ribbon cable in your kit that is 30" long. Cut a piece from it that is 4" long. Separate 1 conductor from the other two of the short piece so that you have 1 conductor 4" long, and 2 conductors 4" long. Put the 1 conductor wire with the rest of the parts. You will use it in Step 24. Prepare the ends of the wires by carefully stripping the insulation back about ¼" Solder one conductor to pin 6 of IC1 and the other wire to pin 7 of IC1. Run the cable through the middle hole of the fence, and split the cable, attach the wire from pin 6 to the dah paddle, and the wire from pin 7 to the dit paddle. Solder the wires to the outer sides of the paddle arms. There is no need to run a ground wire, because the paddle shares a ground with the IC. The usual convention is to use the right paddle arm as the dah, and the left as the dit.

Step 21: Take the long piece of 3 conductor ribbon cable. Solder one conductor to the center lead pad of Q1, and the other to ground. Run the cable through the second hole on the right side of the fence, and then back through the first hole. This will act as a strain relief. Take most of the slack out of it.

Step 22: Run the two wires from the 9 volt battery connector through the left hand hole of the fence from the piezo side. Thread it back through the adjacent hole and then solder the red wire to the +9V pad that C1 and U2 are soldered to. Solder the black wire to ground.

Step 23: Now take the piezo and trim the leads to about 2" long. Solder the red lead to pad 3 of the IC carrier board, and the black lead to ground. Place the piezo in position and attach with two 4-40 screws.

Step 24: Find switch 1. It is designed to be mounted upright on a pc board. Cut the pcboard tabs off. Place the switch as shown on the drawing. Solder the case to the board and the left lead to ground as shown. Take one conductor of the ribbon cable left over from Step 20 and solder one end to the other switch connector, run the wire through one of the access holes, and then solder the other end to pin 4 pad of IC1.

Step 25: Solder the mono 1/8"

plug to the other end of the keyline. Make sure that you get the positive lead to the tip, and the ground lead to the case.

Step 26: Hook up a 9 volt battery to the 9 volt connector. Use a VOM and check to see that you have around 5 Volts at pin 1 of IC1. Do this before you insert the IC. If the voltage checks out, unhook the battery, and insert IC1, making sure that you align pin 1 of the IC as shown in the diagram on page 1. The notch of the IC goes towards the fence. Do not insert the IC with the battery connected. You should hear 3 beeps when you hook the battery back up. Adjust the contact screws for the best feel to you, and you are ready to go. The volume of the piezo is not very loud. It is used to program the keyer chip as explained on the chart on the next page.
If you have problems, go back and check for proper connections and that there are no shorts or solder bridges. The circuit is straightforward and should be easy to debug. If you need more help, contact Jay Bromley at w5jay@alltel.net or

Jay Bromley
9505 Bryn Mawr Circle
Ft. Smith, AR 72908
To order a complete set of parts to build the Ft. Smith P-TiCK, send $10 for the kit, yes that is correct. The cost of the kit is only $10 and that includes all parts, precut pcboard stock, and even the TiCK-1 Keyer chip. Please add $2 shipping and handling for the US & Canada, $4 for Europe and $6 for the Pacific rim countries. Send your order to:

Jay Bromley
9505 Bryn Mawr Circle
Ft. Smith, AR 72908

Please make checks or money orders to Jay Bromley. Also please enclose a self addressed mailing label. Thanks for your support.

ACTION	TiCK RESPONSE	FUNCTION SW1 Released
Press SW1	"**S**" (dit-dit-dit)	**SPEED:** To adjust speed: press DIT paddle to de crease, DAH paddle to in crease
Hold SW1 Down	"**T**" (dah)	**TUNE:** To end tune-up, press either paddle or SW1 again
Hold SW1 Down	"**P**" (dit-dah-dah-dit)	**PADDLE:** Press the paddle you want to designate as the DIT paddle. Default : DIT = tip of stereo jack
Hold SW1 Down	"**A**" (dit-dah)	**AUDIO:** Press the DIT paddle to enable sidetone, DAH paddle to disable. Default: enabled.
Hold SW1 Down	"**SK**"	**STRAIGHT KEY:** Pressing either paddle toggles the TiCK between Straight Key and Keyer Mode. Default: Keyer Mode.
Hold SW1 Down	"**M**"	**MODE:** Pressing the DIT paddle puts the TiCK into Iambic Mode A, DAH paddle puts it into Iambic Mode B. Default: Iambic Mode B
Hold SW1 Down	"**K**"	**KEYER:** If the user releases the pushbutton, keyer returns to normal operation
Hold SW1 Down	"**S**"	**SPEED:** Cycle repeats with speed adjust.

Embedded Research, in Rochester, NY sells an upgrade chip for the Ft. Smith QRP Group Paddle/TiCK keyer kit. It is called the TiCK 4 and has several outstanding features. Order an upgrade today. Be sure and mention that it is for the Ft. Smith Project. You can visit the Embedded Research site on the Web at:

http://www.frontiernet.net/~embres/

There you will find full details on all of their outstanding products.
The TiCK-4
Embedded Research is pleased to announce the newest mem-

ber of the TiCK keyer family, the TiCK-4. The TiCK-4 offers all the features of the TiCK-1, TiCK-2, TiCK-2B, and TiCK-3, plus it offers non-volatile parameter memory! All this in the familiar TiCK 8 pin footprint.

We are committed to bring amateur radio enthusiasts the smallest, most feature-packed keyers. "If you can find a better keyer, buy it!"

Summary of TiCK-4 Features

· Two 50 character, user programmable message memories
· NEW! Non-volatile parameter memory, means no more resetting speed, mode, and other settings after power cycling the TiCK! You can configure the TiCK-4 to you personal settings, and they will remain in effect until YOU change them!
· Pin-for-pin compatible with all other TiCKs (TiCK-1 / TiCK-2 / TiCK-2B / TiCK-3)
· Maintains the familiar and simple TiCK user interface
· Single Pushbutton Interface (SBI) to all functions
· Upgrade your TiCK keyer by simply plugging in the TiCK-4... It's that easy!

Complete TiCK-4 Feature List

Two 50 Character user programmable message memories
Non-volatile parameter memory
Speed Adjust (via paddles)
Tune Function
Paddle Select
Sidetone (ON/OFF)
Iambic Modes A & B
Straight Key Mode
Beacon Mode
Low Current Consumption (1 uA in sleep mode)
Requires 3-5V DC
Uses the very latest in RISC-based microcontroller tech nology
Currently available in 8 pin DIP package and 8 pin SOIC.

We are offering the TiCK-4 as follows:

· TiCK-4 Chip + Datasheet, $15.00, (S/H for CONUS $2.50, DX $5.00)

Payment Information

· We do not at this time accept credit cards - send checks and money orders only!
· For DX orders, an international money order is best.
· All payments must be made in U.S. dollars
· Send orders to:

Embedded Research
PO Box 92492
Rochester, NY 14692

An Improved LED SWR Indicator

by Glen Leinweber, VE3DNL

For rugged portable use, or for sheer simplicity, it's hard to beat a light-emitting diode as an indicator of reflected antenna power (SWR). Figure 1 shows a simple absorptive SWR meter. When SWR is low, the LED emits no light. Sensitivity is poor, meaning that before light is visible, SWR is already fairly high. A low-power transmitter magnifies this problem. Adding a current transformer improves performance at low input power, and extends high power range too.

Circuit Operation

Transmitter power comes into a standard four-resistor bridge circuit, where the antenna load substitutes for one bridge arm. Component values for the remaining three resistors are chosen so that the transmitter will see a 50-ohm load (if the antenna is 50 ohms too). This arrangement has the added advantage that the transmitter will see a fairly reasonable load, even when antenna impedance is wildly off. Worst case SWR that the transmitter will see (when the antenna port is open-circuit) is 2:1. There is a price to pay: only one quarter of transmitter power will reach a 50-ohm antenna load. Once you check the SWR, this circuit should be removed or switched out of the way, else you'll be at a -6 dB disadvantage.

The light-emitting diode puts out light that is proportional to forward current passing through. A high-efficiency LED will start to become visible (in a dark environment) with as little as 50 microamps current. However, current doesn't begin to flow until it is forward-biased about 1.5 volts.

Operating current for the LED comes from the high amplitude radio frequency power coming in from the transmitter. When antenna impedance is either higher or lower than 50 ohms, RF voltage across the bridge arms rises. This RF voltage must be rectified with a diode, since the LED only emits light when its anode is more positive than its cathode. The LED would rectify the RF itself, but not efficiently. A germanium diode or schottky diode helps in this circuit. When the antenna impedance is far enough from 50 ohms to give more than about 2v peak-to-peak across the bridge arms, rectified voltage across the LED is above 1.5 volts, and the LED begins to glow.

The "dead zone" below 2v p-p results in the sensitivity problem. A test with a 2.7 watt transmitter was made to see how high the SWR had to rise before the

LED glowed visibly. For SWR below 1.3:1 no light could be seen. With the antenna short circuited (infinite SWR), the LED was blindingly bright.

Improved Circuit.

To improve SWR sensitivity, the RF voltage across the bridge arms should be made larger. A broadband RF step-up transformer is required (figure 2). When the 1:10 ratio step-up transformer was added, the same sensitivity test was run. For SWR above 1.06:1 light could be seen.

But what about really high SWR - won't the LED burn out from too much current? No, you actually get less light. With lots of LED current flowing, the RF impedance of the primary winding is very low. It is much lower than the resistive bridge arms. Because of this impedance mismatch, less RF power is transformed into LED power. The LED should survive infinite SWR, even when driven from a full teaspoon (5W transmitter). The LED in this circuit can withstand more RF power than in the simple circuit of figure 1.

Building the circuit.

Since 50 ohms is not a standard resistor value (nearest is 51 ohms), two paralleled 100 ohm half-watt carbon film resistors were used in each bridge arm. Since each bridge arm must consume one quarter of transmitted power, you should expect these resistors to get warm. Three 150 ohm resistors in parallel would also work well - allow a little air space around each. Be suspicious of resistors having a power rating of 5W or more: chances are good that they're wirewound - inductance is not desirable. Carbon composition, carbon film or metal film resistors are fine. The arrangement shown should handle a 5W transmitter, if transmitted power is limited to 20 second bursts.

Any germanium point contact diode similar to 1N34 can be used for the rectifiers. A schottky diode is fine too (1N5711). A silicon diode like 1N914 or 1N4148 will work, but sensitivity will suffer a little.

Try to find a high-efficiency light emitting diode. LEDs have improved greatly in recent years; older diodes are significantly dimmer. Red is preferred to any other colour, since red LEDs will start to emit light at lower forward voltage - this helps the sensitivity problem. I find that "water clear" plastic lens material is better than "diffused." Avoid LEDs incorporating series resistors. A good-looking LED (from the Digi-Key catalog):
T 1 3/4 SUPER BRIGHT WATER CLEAR RED (LITEON) LT1102-ND, or LT1103-ND or LT1104-ND.

For any portable operation,

this 50-ohm SWR indicator is simple, robust and inexpensive. It should work well at any frequency from 3 to 30 MHZ. and is optimized for transmitter power in the half watt to seven watt range. While you can't actually measure SWR, you can check that your antenna is good, or you can adjust an antenna tuner for best match. It's a simple circuit that only takes an evening's work

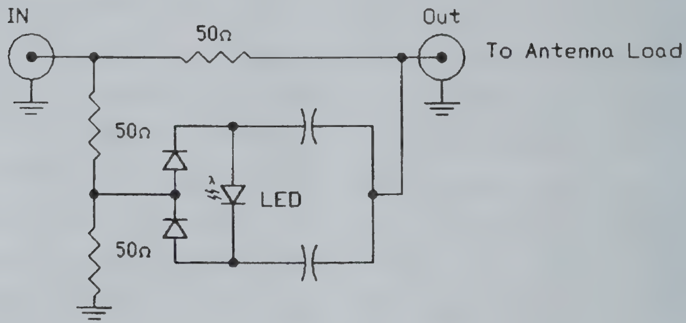


Fig. 1 Simple but insensitive

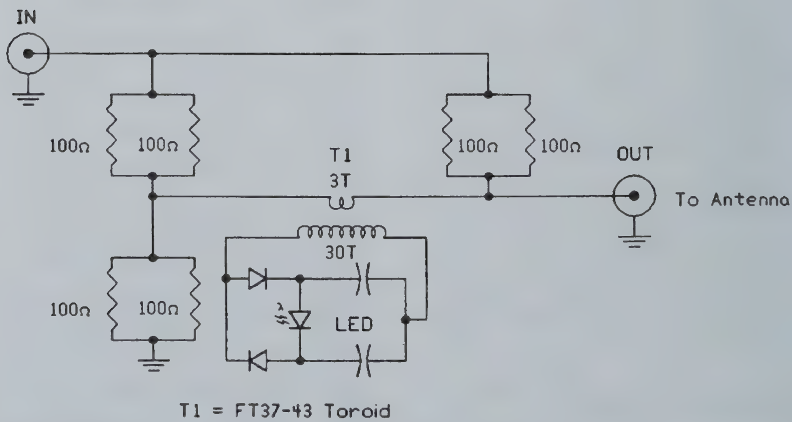


Fig. 2 Sensitive SWR Indicator

A Microphone Preamp For The Elecraft K2

by Jerry Haigwood W5JH

Introduction

The K2 is the best thing that has happened to QRP in a long time. Eric Swartz, WA6HHQ and Wayne Burdick, N6KR (owners of Elecraft) had sold over 750 radios by the end of 1999. To say the K2 is a popular radio would be some what of an understatement. The philosophy of Elecraft and the K2 is also very different from any other manufacturer. Elecraft invites you to experiment and modify the radio (see chapter 9 of the K2 manual). How many manufacturers would allow you to modify your radio and still warranty the unit? It is in this spirit that this article is written.

Some people have reported low transmit audio while using the Elecraft SSB unit for the K2. It appears that the K2 SSB unit was designed for a dynamic microphone with a reasonably high output. Some users have tried using electret or similar microphones with lower output without good results. What is needed is a microphone preamp.

The Mechanical Design

This microphone preamplifier is very small and was designed to not only work with the Elecraft K2 transceiver but with many microphones that need a "boost" in their output. This preamp was designed to fit INSIDE the K2 using the microphone configuration connector P1 as a "holder" although this preamp is small enough to fit into many microphones. There are sixteen pre-drilled holes on the circuit board allowing the preamp to slide onto the K2 microphone configuration connector. The preamp is held in place by configuration jumpers and wire wrap points. If you decide to mount the preamp inside of a microphone, you can cut off the 16 holes to reduce the board size.

How it Works

The microphone preamp is a single transistor amplifier in a common emitter configuration. Resistors R1 and R2 are used to bias the transistor. Input impedance of the amplifier is on the order of 1700 to 2300 Ohms depending on the value of R2 and R4. This is a good match for low impedance microphones. The collector resistor 1K Ohm was chosen as a good match for the K2 microphone input circuit. The voltage gain of this amplifier is approximately R3 divided by R4. Several values of R2 and R4 are shown to set the gain to the desired value. The input and output are coupled using small tantalum capacitors.

Programmable Gain Resistors

This preamp uses a programmable gain feature. This is accomplished by changing the value of two resistors. Before mounting R2 and R4, you must decide how much gain your microphone needs. It is best to start with the smallest amount (Av=3) test it and determine if you are satisfied with the results. Some of the things that will affect your gain choice are:

- Can the VOX be triggered and held in a normal voice?
- Can full rated output be had (10 watts)?
- Can any distortion be heard?

If you can already hold the VOX in on the K2 while speaking in a normal voice, you do not need any more microphone gain. The K2 VOX circuitry seems to require a slightly higher level than the level required to produce full RF output. It is a good indicator that you have enough microphone gain. When selecting gain, start with the lowest gain (Av=3) try it out and get several reports. Try to hold the VOX in a normal voice. If you can, you are finished, else continue increasing the gain until you can hold the VOX in and there is no distortion on your signal. Note: Make sure you have SSBA set to 2 or 3!

Getting The Parts

The Arizona ScQRPions QRP Club is making a kit available. To order send $10 for a complete parts kit and a pcboard to:

Bob Hightower
1905 Pennington Drive
Chandler, AZ 85224-2632

The sources mentioned here are where I obtained the parts for the prototype. Mouser Electronics (800) 346-6873 can supply the 2N4401, all of the 1/8 watt resistors and the two tantalum capacitors. Your local Radio Shack store has wire wrap supplies including a wire wrap tool and wire. Radio Shack also has proto boards which can be used to build this preamp.

Building Instructions

This preamp can be built using several techniques. A proto board with holes and copper rings every 0.1 inch can be used and was used during the development phase. If you are good at making PC boards, an etching pattern is provided. This board is quite small (less than 1 square inch) and fits into the K2 nicely.

The following instructions assume you are building the preamp using the PC board shown. However, the same instructions can be used if you are using the proto board mentioned

above. Note: all parts for the preamp are soldered on the trace or foil side of the PC board. No holes for the components are provided. The parts are mounted "surface mount" style. Each lead is tacked down with solder using a low wattage soldering iron with a small tip. A magnifying glass and lamp will help identify each component.

1. Identify and inventory each part before proceeding.

2. Place the PC board in front of you with the trace side up and the holes to the right side. Using the Parts Placement guide, install Q1 first. Q1 has a flat side (face) and a rounded side. Place the flat side face down against the PCB with the leads protruding to the left. Bend the leads to lay flat on the board and trim the length to allow soldering but not allowing shorting. Solder the leads to the 3 traces shown.

3. Locate R1 and R3. Bend the leads so that the resistors will lay flat against the board and trim them to fit the correct pads. Solder the leads.

4. Locate the programmable resistors R2 and R4 which you have selected. Bend the leads so that the resistors will lay flat against the board and trim them to fit the correct pads. Solder the leads.

5. The capacitors C1 and C2 are mounted on their side with the capacitor body protruding to the left away from the 16 holes. Bend and trim the leads. Insure you have the correct polarity before soldering the leads.

6. Inspect the board under a magnifying glass and strong lamp. Check for shorts, unsoldered leads, etc.

Mounting Instructions

If you are mounting the preamp into a microphone, you only need to connect +5 volts, ground, input, and output. The mounting choice will be yours. Take into account shorting problems when selecting a mounting method. Double sided foam tape works well especially in hand microphones where everything is held tight by tightening the case screws. If you are mounting the preamp into the K2, use the following instructions.

The Elecraft K2 uses a 16 pin header (P1) for microphone configuration. For these instructions, the pins will be labeled K2-1 through K2-8 on the Elecraft side of P1 and MIC-1 through MIC-8 on the Microphone side of P1. Six wires are used to connect the Preamp to the K2.

These wires are connected using wire wrap techniques. The

preamp can easily be removed at a later date - no permanent changes are made.

1. Prepare six wires of insulated #28 or #30 wire by cutting each wire 2.25 inches long. Strip 1 inch of insulation from one end of each wire. Strip 0.1 inch from the opposite end of each wire.

2. Using two of the prepared wires, twist the 0.1 inch bare ends together and solder them to the +5V pad.

3. In a similar manner, twist and solder two wires to the GND pad.

4. Solder the 0.1 inch end of one of the remaining wires to the INPUT pad.

5. Solder the 0.1 inch end of the last wire to the OUTPUT pad.

6. In order to Install the preamp into the K2 you must first: remove the Top Cover, remove the Control Board, and remove the Front Panel Assembly. Lay the Front Panel Assembly face down on a soft cloth with P1 toward the right. Remove any jumper wires on P1 (Note: If you soldered wire onto P1, you will need to remove all solder before trying to mount the preamp). Slide the preamp board over P1. Make sure the preamp board protrudes to the left of P1. The friction of the 16 holes/pins along with the wire wrap leads to be placed on the pins are used to hold the preamp in place. Once the preamp is in place, choose the following instructions which match up to your microphone type.

KENWOOD

For a Kenwood type of microphone (as defined in the Elecraft SSB manual page 16), use the following instructions:

Make the following connections using a wire wrap tool:

Preamp +5V pad to K2-6
Preamp +5V pad to MIC-5
Preamp GND pad to K2-7
Preamp GND pad to MIC-7
Preamp INPUT pad to MIC-1
Preamp OUTPUT pad to K2-1

Configuration jumpers should be used to connect:

K2-2 to MIC-2
K2-3 to MIC-3
K2-4 to MIC-4
K2-8 to MIC-8

ICOM

For a Icom type of microphone (as defined in the Elecraft SSB manual page 16), use the following instructions:

Make the following connections using a wire wrap tool:

Preamp +5V pad to K2-6
Preamp +5V pad to MIC-2
Preamp GND pad to K2-7

Preamp GND pad to MIC-7
Preamp OUTPUT pad to K2-1
Preamp INPUT pad to MIC-1

(See Elecraft manual about connecting a resistor from this pin to +5V. The resistor can be mounted on the preamp board.)

Wire Wrap can be used for the following connections:

K2-8 to MIC-6
K2-2 to MIC-5

A configuration jumper can be used to connect:
K2-3 to MIC-3

YAESU

For a Yaesu type of microphone (as defined in the Elecraft SSB manual page 16), use the following instructions:

Make the following connections using a wire wrap tool:

Preamp +5V pad to K2-6
Preamp GND pad to K2-7
Preamp GND pad to MIC-7
Preamp INPUT pad to MIC-8
Preamp OUTPUT pad to K2-1

Wire Wrap can be used for the following connections:

K2-8 to MIC-2
K2-2 to MIC-6
K2-4 to MIC-1

A configuration jumper can be used to connect:
K2-3 to MIC-3

Some Yaesu microphones require +5V on MIC-5. However, the wiring diagram for the Yaesu MD1 microphone shows pin 5 as GROUND. Investigate your microphone diagram thoroughly before connecting +5V to this pin. If +5V is not required by your microphone, then remove the extra +5V wire wrap lead.

Testing

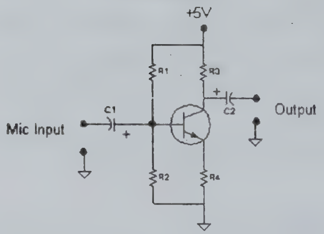
The preamp is best tested using the criteria outline above (choosing the programmable resistors). It is best to listen to yourself on a second receiver while transmitting into a dummy load to determine the effect of the preamp.

Removal

The preamp can be easily removed. Just remove the configuration jumpers, remove the wire wrapping, slide the board off. You will then need to reconfigure the microphone interface (P1).

A Microphone Preamp For The Elecraft K2

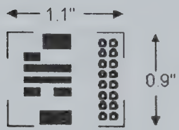
Schematic



Parts List

C1, C2	6.8uF/16V Tantalum Capacitor
Q1	2N4401 Transistor
R1	10K 1/8W 5% Resistor (BRN-BLK-ORG)
R2	See Gain Table
R3	1K 1/8W 5% Resistor (BRN-BLK-RED)
R4	See Gain Table
PCB	Small Printed Circuit Board

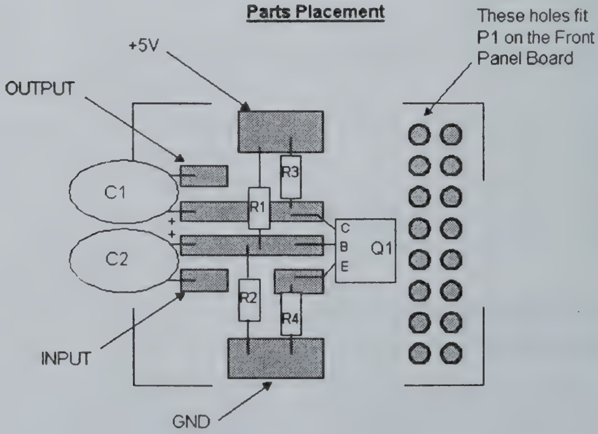
Board Layout



Gain Table

Gain	R2	R4
3	3.9K 1/8W 5% Resistor (ORG-WHT-RED)	330 1/8W 5% Resistor (ORG-ORG-BRN)
4.5	3K 1/8W 5% Resistor (ORG-BLK-RED)	220 1/8W 5% Resistor (RED-RED-BRN)
6.6	2.4K 1/8W 5% Resistor (RED-YEL-RED)	150 1/8W 5% Resistor (BRN-GRN-BRN)
8.3	2.4K 1/8W 5% Resistor (RED-YEL-RED)	120 1/8W 5% Resistor (BRN-RED-BRN)
10	2.4K 1/8W 5% Resistor (RED-YEL-RED)	100 1/8W 5% Resistor (BRN-BLK-BRN)

Parts Placement



Operating News

By Richard Fisher, KI6SN
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Riverside, CA 92506
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'VY 72' TO ALL

The first order of business in this quarter's edition of Operating News is to thank all of you who took the time and energy to send your kind letters of support following the debut of QRPp's newest column in last quarter's edition.

"Vy 72" to you all.

One of the finest attributes of the QRP community is the wonderful support it has given to efforts such as this. You may suspect that some columnists take this kind of thing for granted. I can assure you that, as one who has covered the QRP scene for many, many years, this columnist doesn't.

Thank you very, very much.

And here's hoping that you keep those cards, letters and e-mails coming in. Sharing your successes, failures and challenges with the rest of QRPp readers enriches the low power experience for us all.

And now I yield the floor to you . . .

- R.E.F

WHY NOT GIVE 12 A TRY?

Randy Foltz, K7TQ, writes from Moscow, ID, that on Feb. 12, he "gave 12 meters a try. First at 2338 Z I worked JN1NOP using 2 w. He was 559 and gave me a 539. Japan to Moscow, ID is around 4,800 miles depending where in Japan, so this was over 1,000 miles per watt.

"I thought that sure was easy, so I turned the K2 down to 900 milliwatts and gave JA1OSN/7 a call at 2348 Z. He was 579 and gave me a 559.

"Now I had about 5,000 miles per watt. Down went the power again to 500 milliwatts and at 0001 Z Feb 13 I gave JA8BGR a call.

"He got my call first time around and gave me a 559 to his 589. This one was 8,990 miles per watt.

"Now I wanted 10,000 miles per watt, so down went the power to 200 milliwatts. Again I looked for strong station and found JN2QYN/2 calling CQ at 0012Z.

"He also got me on the first try and gave me a 339. He was 579. This was good for about 25,700 miles per watt.

"Each of these powers were at initial call up. Those guys sure did have good ears!

"Each will get a QSL and a 1,000 miles per watt certificate. For those who are interested, my antenna is a GAP Titan. Most of the JAs reported 4 or 6 element yagis. Give 12 meters a try. It can be a great QRPp band."

A MYSTERY RADIATOR, INDEED

Caity Martin, KU4QD, writes from Morrisville, NC, that "I was on 15 meters recently with my newly re-acquired NCG 7/21/50.

"And despite fairly good band conditions, I was getting fairly poor signal reports with my vertical.

"I had tried working my friend Dave in Colorado, and we couldn't make a go of it.

"There was a Girl Scout special event station on from Dallas, and I decided to forsake QRP and use my 20 watt Tokyo Hy-Power monobander (that is QRO for me), and after talking to a couple of the girls, I faded out on them.

"As a woman in ham radio I really wanted to encourage them, so this was really frustrating.

"Clearly, I needed to do better, and besides, Dave wanted to try later on 40, and my vertical antenna is terribly inefficient there. So . . . it was time to string a new wire antenna.

"At Dave's suggestion, I ran a length of wire down from my antenna tuner's ground post to a water pipe.

"We knew this would radiate, since I

live upstairs, so it would act at least as much as a counterpoise or as a part of my antenna as a ground.

"Anyway, the remainder of my spool of wire (which also was used to make little radials for my six meter vertical) was thrown up into the trees, and my original thought was that I was doing an end fed long wire.

"As it turns out, this was not quite true.

Anyway, Dave was able to hear me FB with 10 watts on 40, but I was having an awful time trying to hear him.

"A station in Ohio could hear both of us just fine, but that would never do. It was almost two hours after local sunset, but I asked Dave to stand by and flipped back to 15.

"There weren't many signals, just the usual Latin American 'kilowatts' and a few others, but I decided to try anyway.

"Sure enough, well into the evening, we were both enjoying beautiful armchair copy on 15.

"So, what went right? There was approximately 66'-67' of wire left, as it works out, and we all know that is a quarter wave on 40.

"I think what we made here is some kind of weird, off-center fed dipole, one part vertical, one part sloping upwards from the feed point on the second story to a peak maybe 35' up.

"I'm not sure exactly what it is or why it works, but signals are at least three S-units above the vertical on both 15 and 40, and it is pretty well resonant on both bands.

"I'll see how well it tunes up on 10 and 20 next. The antenna tuner should be able to handle it, no matter how weird a load I am presenting (it), anyway.

"The question is whether it will be at all efficient on other bands. I suspect it will act as a true long wire on 10, and that should be OK.

"So . . . look for me to have stronger signals from now on.

"The moral of the story: even in an apartment environment, something will work, even at QRP power levels, and it sure doesn't take much money to make something that works well.

"I'm feeling very lucky about now."

AN UNSCIENTIFIC SUCCESS

Mark Hogan, N5OBC, of Broken Arrow, OK, writes that a recent weekend "brought another attempt at getting a signal out on 160 meters from my city lot.

"I read most of the antenna articles in the new SPRAT CD and thought I'd just hang a bunch of wire.

"(The result) is a cross between a bobtail curtain and a 'garden antenna.'

"At initial loading I had 300 ohms to the tuner and ended up with RF in the shack.

"That's when I ran the RG 8 out and up on the roof and whacked the 300 ohm where the RG 8 met up (scientific huh?).

"I did not have a balun, so I skipped that part and soldered direct to the RG8.

"The rig loaded on all but 20 meters. On that band I still have RF in the shack, (my personal computer speakers buzz even with three watts.)

"All other bands loaded to 1:1.1

"Yes even 160. The next test was to see how well did it hear.

"The guys on 40 that were S9 recently with the offset dipole were now +20 to +40.

"I had asked them for signal reports on the weekend before. They said I was readable but poor.

"This time they asked if I was running an amplifier.

"I was from +10 to +20 over to the north-northeast and south.

"Everyone I spoke with said I had a very good signal for 100 watts, (I know this is a QRP periodical, but you've got to remember, I was testing . . .)

"As the evening progressed I got brave, loaded 160 meters and spoke to Dallas and Beaumont, TX.

"I had been on 80 meters the week before and was low but readable, so loading it on 3.916 MHz, I asked if I could be heard and again they were

surprised that I was not running any more then 100 watts.

"The signal reports were again from S9 to +20 over around Texas, Indiana, Tennessee, Arkansas, Oklahoma, and Arizona.

"What did I learn from this?

"It sounds better then the last attempts. I can hear a lot more people and quite a few of them can hear me, (which is what I was after!).

"I suppose the best thing I learned is - as someone said the other day - any antenna is better then no antenna.

"I am by no means a contest station, nor, as you can surmise, not very scientific (it takes too much effort).

"All I really wanted was to emit a signal and be heard!

"I hope this boosts my CW QRP efforts on 40 and now I think I can try 80 for some nets as well.

"I was very careful cutting the top section, cut a piece of 70' wire in half and let it hang from the ends as I raised the antenna.

"The ends were pulled to within 8' or so of ground; cut twisted through some insulators and tied off to my privacy fence.

"They run down about 90 degrees but off to the side in order to be a little longer.

"I've had a RG 8x / balun fed 66' dipole, a 300 ohm fed 66' dipole, an offset 66' dipole fed with 300 ohm wire - all at the same height as this and one 66' sloper, but this is the loudest I've heard or been heard so far."

300 MW GOES A L-O-N-G WAY

Brad Hutton, W1XV, writes from Bow, NH, that "for all those who posted QRP-L listings on the recent ARRL DX Contest, congratulations for a job well done!

"Of course, every exchange is 599 both ways . . . is it ever different than that?

"You *have* to smile, though, when you're running a fraction of a watt and the other guy sends "599 KW" . . . then he acknowledges your 300 milliwatt signal.

"Just goes to show you, doesn't it?

"I dabbled at the contest off and on and never spent more than 30 consecutive minutes in the radio shack because of other things to do.

"However, I did manage about three hours of operation during which time I made 53 contacts in 43 countries (including all 6 continents) with less than a watt.

"I used an Omni VI for 10 and 15 meters and an OHR 100A for 20 meters.

"The Omni will only go as low as 1,100 milliwatts on 20 meters.

"I did work Australia on 10 meters with 5 watts, but I needed a VK for DXCC QRP CW and didn't want to miss it.

"I tried in vain to work him with less than a watt but it was fruitless.

"I only answer CQs, but I do believe that I worked everyone to whom I responded.

"I upped my total of DXCC milliwatt countries by 5 to a new total of 85.

"The closer you get to 100, the tougher it is to find a new one!

"New ones worked were: ZD8, 6V6, TG, ER and KP2.

"I have only 37 countries confirmed but I am not going to support the postal system this time around – through the bureau or a stateside manager only is my new moto.

"The crux of this note is to get others interested in milliwatting.

"As you can see, it is fairly easy to snag 50 or so countries during a contest weekend.

"*They* want you in the log and will dig you out of the ether for a point!

"I have found that the second day of a contest is much more rewarding so usually concentrate on Sunday operating times.

"I didn't mention that I have an OHR WM-2 wattmeter that stays in line all the time with all the rigs. Nifty piece of equipment, to say the least!"

10 METER DX VIA QRP H-T

Brian Mileshosky, N5ZGT, writes from Albuquerque, NM, that "it begins with me buying an AEA DX-Handy 10 meter QRP HT about 3 years ago for $125 when the solar cycle wasn't all that good.

"The HT is in perfect condition with two crystals, one for the CW subband and one for the SSB subband.

"Not even a scratch on the housing!

"Three years later, I pull it down from the closet shelf to give it a whirl since I'm on break from school and have lots of radio time all of a sudden.

"Standing in my backyard, putting out 1.5 to 2 watts with the AEA AN-28 10 meter whip (its gain is -2 dB according to specifications), I manage to get a hold of WH6WI in Hawaii on 28.325 USB.

"At first he had a rough time copying but after turning on his 706's pre-amp, he could copy me fine.

"He gave me a 5-1 though, but there was a lot of QSB on the band and many adjacent Central and South American stations. Not bad!

"I'm getting a card for this first QSO with this HT.

"I tried it on CW, but I heard nothing but beacons. I'd like to build a beacon myself one of these days.

"Anyway, I hope that everyone has been enjoying the bands."

. . . AND MORE CONTEST FUN

Jim Larsen, AL7FS, writes from Anchorage: "Greetings from Alaska.

"It was a real treat to work LY2FE and UA1DW in (a recent) contest.

"Conditions were very bad for Alaska but not as bad as two years ago.

"I had to wait for the signals to fade up so I could work a few, then it would fade out and there would be no signals on any QRP segment of any band.

"In 15minutes to an hour it would be back.

"My log times show the ups and downs.

"Later the cycle seemed to shorten to 5 to 10 minutes. The whole contest was fun and I appreciate all who listened for me.

"I worked 23 states and six countries (Alaska, Hawaii, USA, Canada, LY2, UA1).

"I had two contacts on 10 meters, 16 on 15 meters, 27 on 20 meters and five on 40 meters.

"Amazingly, the states ranged all over the U.S.:

"Alaska, Alabama, Arizona, California, Colorado, Connecticut, Florida, Hawaii, Iowa, Idaho, Illinois, Massachusetts, Maryland, Maine, North Carolina, North Dakota, Nevada, New York, Ohio, Oklahoma, Oregon, Texas and Washington.

"With conditions as bad as they were, I was very surprised.

"Many of you may have worked NL7Z, Kevin from Wasilla, Alaska.

"He normally runs a kilowatt but he tried QRP at about 3 watts this contest weekend and I think he was pleased.

"He said it was nice not to have the loud fan from the amplifier running in the background.

"During the contest I had a total of 200 QSO points multiplied by 35 SPCs multiplied by 7 (1-5 watts) for a grand total of 49,000 points.

"I was running a Kenwood TS-450S running 5 watts.

"My antenna was a KLM KT34A at 40 feet + 2 elements on 40 at 38 feet."

-- 72, Richard Fisher, ki6sn

QRP HINTS & KINKS

A NorCal Exclusive

Illustrated by Paul Harden, NA5N

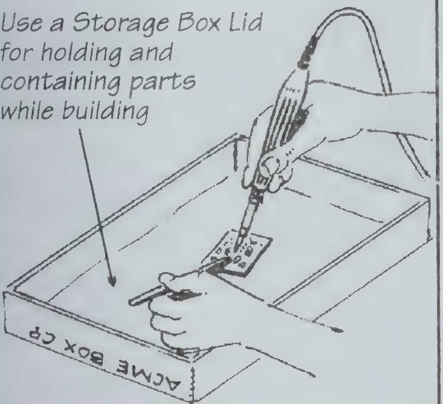
#11 Surface Mount Construction & the SMK-1

Keeping track of those teenie-weenie parts (TWP's)

The SMC "Play Box"

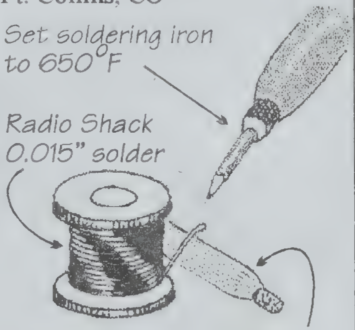
From Walt Amos, K8CV

Use a Storage Box Lid for holding and containing parts while building



Good Soldering Tips

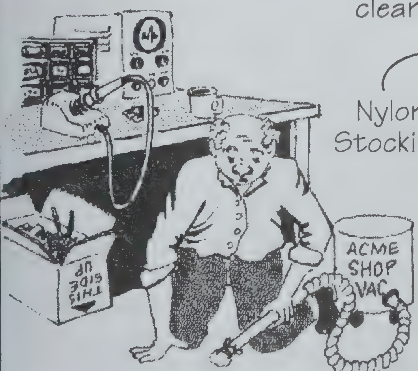
From Rod Cerkoney, NØRC
Ft. Collins, CO

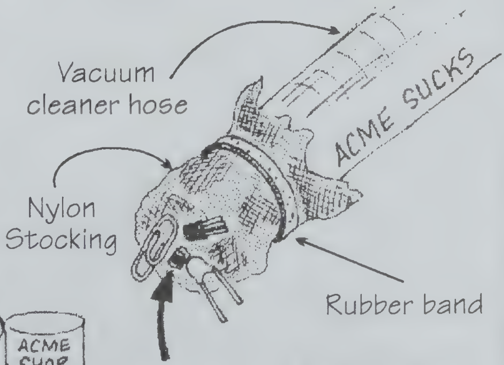


Kester "Flux-Pen" #551 for wiping pad before soldering (Mouser #533-0951)

SMC Sucker-upper

From Bob Parks, K6AEC
Las Vegas, NV





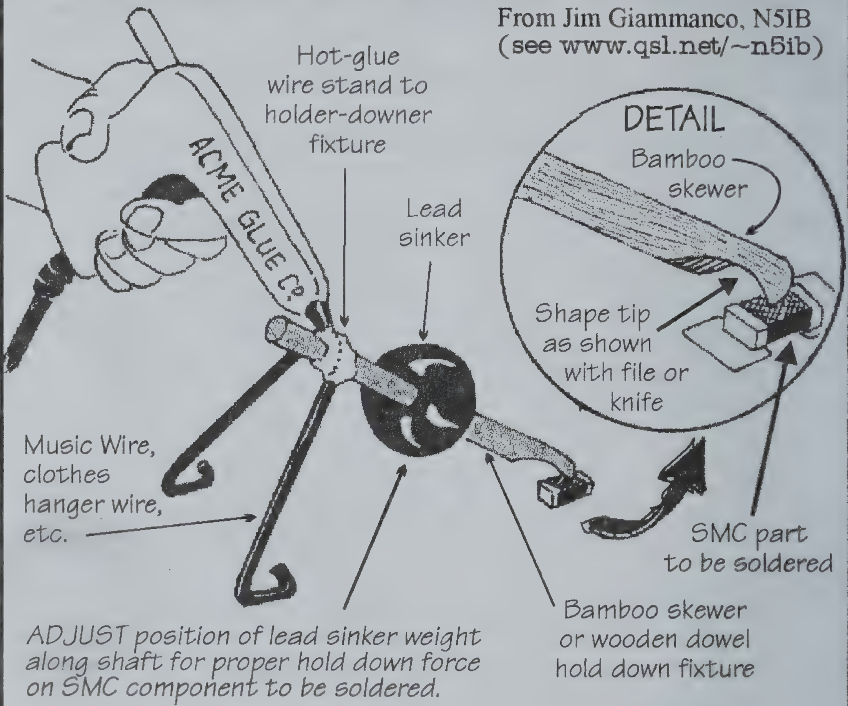
Nylon stocking acts as a filter for finding lost SMC parts dropped on the floor, shaggy rugs, etc. with vacuum cleaner. (Bob ... did your XYL notice the missing nylons yet?)

Hold-down (3rd Hand) Fixtures for Soldering SMC Parts

"Goofy-looking goose-shaped holder-downer doofuses"

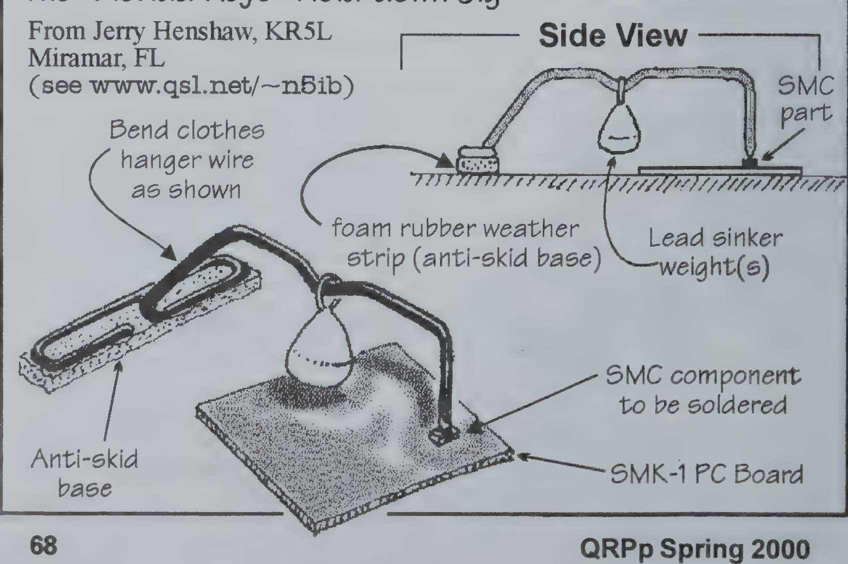
As originally described (and named!) by Mahlon Haunschild, N4EEE

From Jim Giammanco, N5IB
(see www.qsl.net/~n5ib)



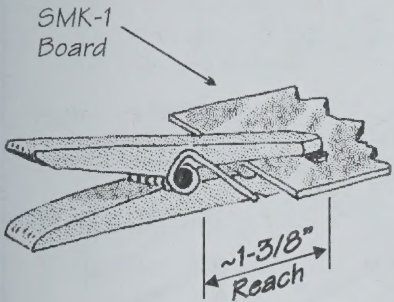
The "Florida Keys" Hold-down Jig

From Jerry Henshaw, KR5L
Miramar, FL
(see www.qsl.net/~n5ib)

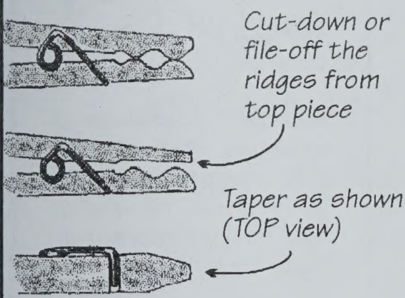


Clothespin Hold-down

From James Rue, KC5HAC

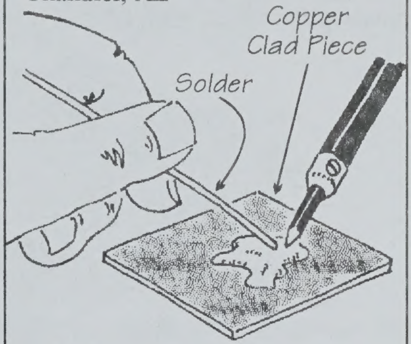


James uses a simple clothes pin, modified as shown below, for holding down the SMC parts.

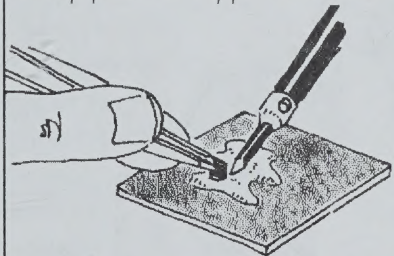


SMC Tinning Aid

From Bob Hightower, NK7M
Chandler, AZ



Form small pool of solder on a scrap piece of copper clad board

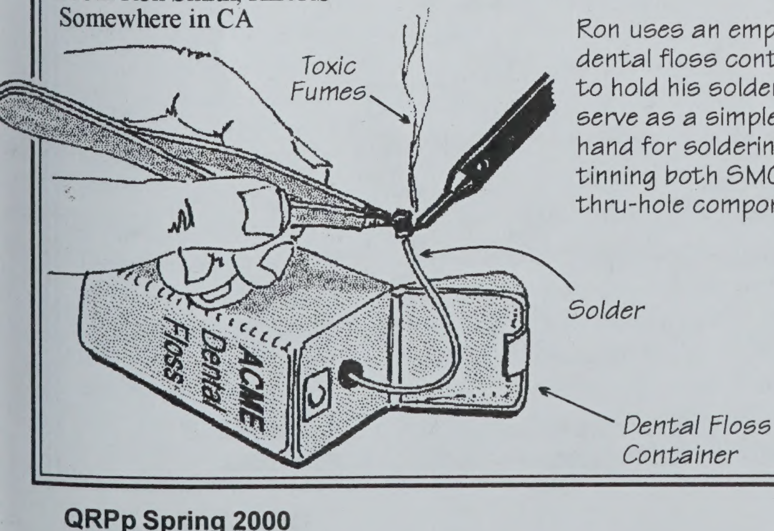


Re-heat pool of solder to "tin" SMC component.

A "3rd Hand" for Soldering

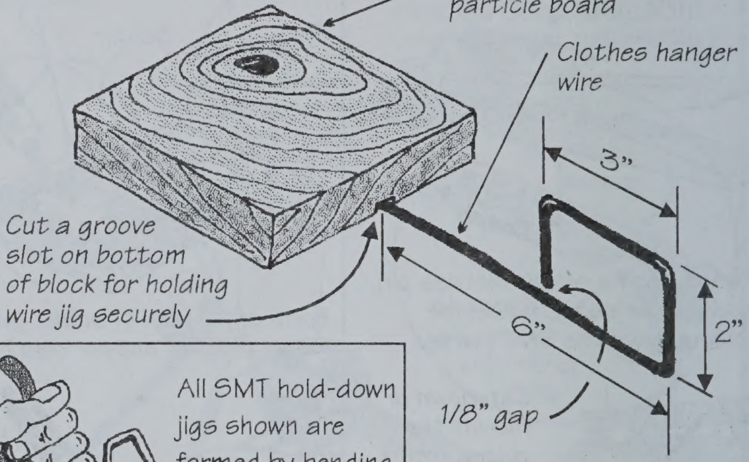
From Ron Smith, KE6RS
Somewhere in CA

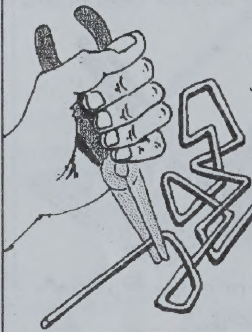
Ron uses an empty dental floss container to hold his solder AND serve as a simple third hand for soldering and tinning both SMC and thru-hole components.



The "Yet Another SMT Hold-down Jig"

From Bill Jones, KD7S
For details see
www.psnw.com/~kd7s



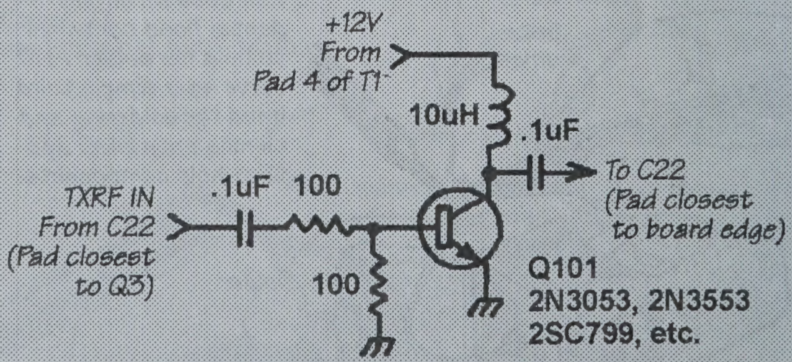


All SMT hold-down jigs shown are formed by bending coat hanger or buss wire to desired shape with pliers.

Build SMT hold-down jig as shown. Adjust the 6-inch length for proper "springiness" desired to hold SMT component in place for soldering.

Easy 1-Watt Mod for the SMK-1

Designed by: Wayne McFee, NB6M



For more details, see the NorCal website:
www.fix.net.com/norcal/smk1

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